Capability Portfolio Status Report

High End Computing Capability

May 10, 2019

Lomb2@nocturne

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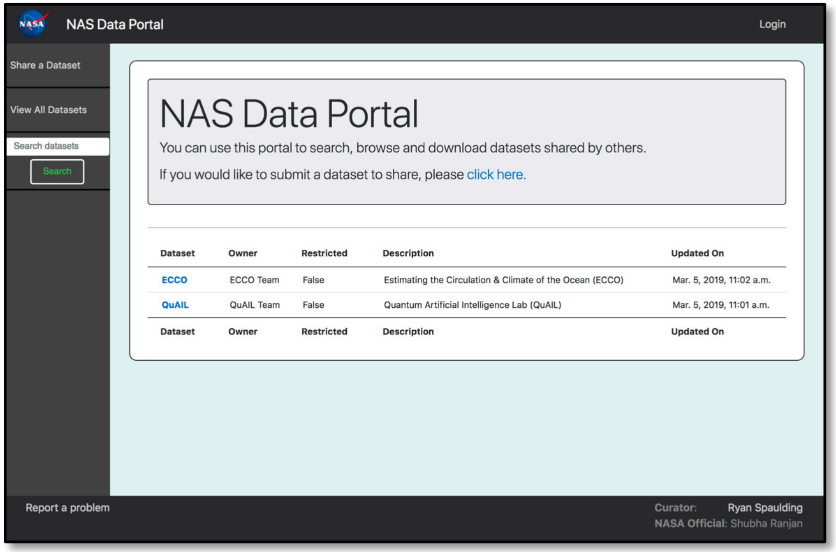
HECC Big Data Team Launches Data Portal

- HECC's Big Data team launched the NAS Data Portal to allow users to share large datasets while meeting security requirements. Datasets can be shared with the general public or with select NASA collaborators.
- HECC Users can submit datasets for dissemination using the data portal. The data could be accessible by the general public or could be restricted to specified set of collaborations.
- External users can browse through the public datasets and download them.
- Online forms are provided for dataset submission, updates, and approvals.
- URLs are generated that can be used to reference shared datasets in scientific papers.
- The portal leverages existing HECC resources:
  - Re-exporter is used to make Lustre filesystem data available outside the NAS enclave.
  - Data is shared in-place; no data movement.
  - Authentication with NASA Launchpad.
- See: https://data.nas.nasa.gov/

Mission Impact: The new NAS Data Portal, which takes advantage of existing HECC resources, provides researchers with a platform to share large datasets with collaborators or the public to promote innovation and scientific discovery.



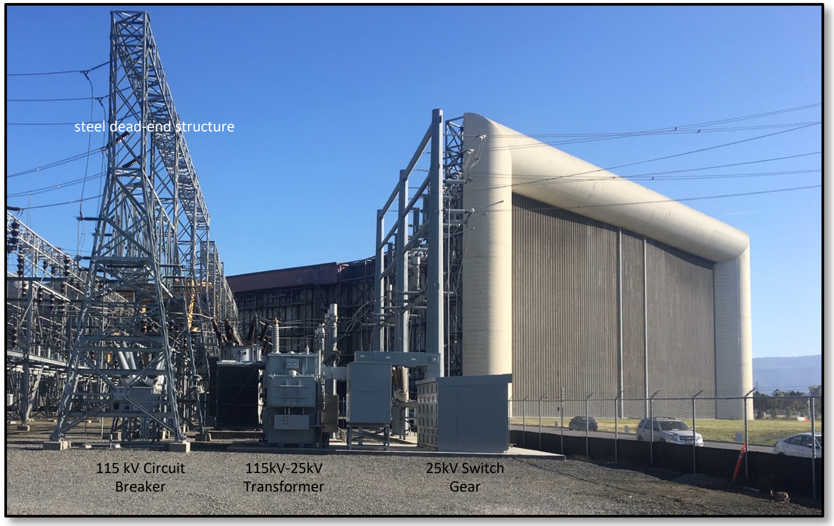
The NAS Data Portal allows users to easily share multi-gigabyte datasets, and to download datasets shared by others.

POCs: Shubha Ranjan, shubha.ranjan@nasa.gov, (650) 604-1918, NASA Advanced Supercomputing (NAS) Division;
Glenn Deardorff, glenn.deardorff@nasa.gov, (650) 604-3169, NAS Division, ASRC

NFE Site Powered Up: Energization of New Transformer Completes Phase 1

- The new 30-megawatt (MW) transformer for the NAS Facility Expansion (NFE) was energized on April 18.
- The transformer, located in the NASA Ames N225B substation, feeds power to the NFE site, located a quarter-mile north of N225B, via new underground feeders.
  - The transformer distributes 25-kilovolt (kV) power to the NFE site, the highest transformer secondary (distribution) voltage at Ames.
  - Switchgear at the NFE site distributes the 25kV power to each module
- With the energization of the transformer, the "Phase 1: Primary Infrastructure for NFE" tasks, are complete.
  - Phase 2: Secondary Infrastructure, installation of the first module, and the full site concrete pad is targeted for completion in July 2019.
- Four Cascade Lake HPE E-Cells will be installed after the module is installed and commissioned.

Mission Impact: The NAS Facility Expansion will provide the infrastructure to support four times the amount of existing HECC resources to support NASA's ever-increasing demand for supercomputing resources.



Electrical equipment for the NAS Facility Expansion is located in the N225B substation at NASA Ames. New equipment installed for the project (from left to right): steel dead-end structure to support incoming power lines, 115-kilovolt (kV) circuit breaker, 115kV-25kV transformers, and 25kV switchgear.

POC: Chris Tanner, christopher.tanner@nasa.gov, 650-604-6754, NASA Advanced Supercomputing Division, ASRC

Electra Firmware Updates and Cooling System Upgrades Improve Availability

- During a scheduled dedicated time, HECC systems staff and Hewlett Packard Enterprise (HPE) engineers made a number of improvements to Electra.
- HPE engineers upgraded the cooling distribution units in Module 2 with an additional expansion tank. Future maintenance or repairs to any of the expansion tanks can now be performed seamlessly while the system is in production.
- Systems staff updated components to the latest available firmware, providing important bug fixes, performance improvements, and monitoring features:
  - Computer rack components from HPE.
  - InfiniBand networking from Mellanox.
- Verification tests confirmed that Electra performed as expected after all updates were completed, and the system was made available to users ahead of schedule.

Mission Impact: Improvements to the Electra modular supercomputer's firmware and hardware provide a more reliable and higher performing system for NASA workloads.

Modules 1 and 2 of the Electra supercomputer are configured with 1,152 Broadwell nodes and 2,304 Skylake nodes. These modules comprise the Modular Supercomputing Facility located adjacent to the primary NASA Advanced Supercomputing Facility at NASA Ames.

POCs: Bob Ciotti, bob.ciotti@nasa.gov, (650) 604-4408, NASA Advanced Supercomputing (NAS) Division;
Greg Matthews, gregory.a.matthews@nasa.gov (650) 604-1321, NAS Division, ASRC

Mini-hyperwall Operating System Upgraded to Red Hat 7.6

- ESS system administrators upgraded the mini-hyperwall operating system to Red Hat 7.6., which allows the system to use the latest software tools.
- The upgrade includes the capability for hardware rendering of graphical images, which allows high-resolution (6K) animations to be displayed smoothly, without stuttering.
- The mini-hyperwall serves as the main venue for presentations and demonstrations of work done on HECC resources during facility tours for visiting VIPs, students, and other guests.
  - This allows the original hyperwall to be reserved for VVIPs, interactive sessions with scientists to explore their ultra-high-resolution datasets, and for use as a cluster to compute new visualizations.
- ESS staff are now updating the system's monitors to increase reliability and to better show large animations and presentations.

Mission Impact: The mini-hyperwall will be a better system for presenting scientific results computed at the NASA Advanced Supercomputing facility to both local visitors and attendees at the annual Supercomputing conference.

NAS visualization expert David Ellsworth at the console of the mini-hyperwall, which is displaying three views of three different cases of a simulation of the Space Launch System Scale Model Acoustic Test. The computational fluid dynamics simulation was performed by HECC user Tanner Nielsen at Marshall Space Fight Center.

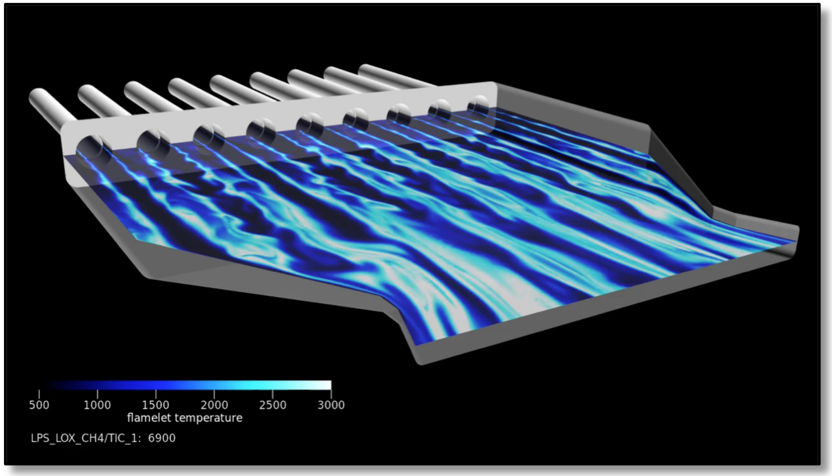
POC: Robert C. Shaw, robert.c.shaw@nasa.gov, 650-604-4354, NASA Advanced Supercomputing Division, ASRC

High Fidelity Combustion Modeling for Deep-Space Exploration*

- Researchers at Marshall Space Flight Center (MSFC) modeled the complex physics of methane gas ignition on Pleiades, in order to understand how to ignite NASA's future deep-space engines.
  - Supports an MSFC task to develop a propulsion system fueled by liquid oxygen (LOX) and methane (CH4).
  - Uses MSFC's LOCI/Chem and Loci-STREAM suite of CFD software to analyze various propellant mixing and ignition scenarios to support development of LOX/CH4 in-space propulsion systems.
- Methane ignition presents unique and difficult challenges and poses a significant risk for in-space ignition. The MSFC team's work includes:
  - Demonstrated the capability to model the time-accurate ignition process of oxygen and methane for a complex geometry.
  - Developed the experience to identify how and where ignition will occur in a rocket combustion chamber.
  - Validated CFD results with experimental observations, providing confidence in their modeling approach.
- The team is developing and testing higher fidelity, complex fluid physics models, including propellant phase change, droplets, and volume-of-fluid models to add to future simulations.

** HECC provided supercomputing resources and services in support of this work.*

Mission Impact: Reliable ignition of an in-space propulsion system is essential for NASA mission success and astronaut safety. Without the availability of HECC's Pleiades supercomputer, NASA MSFC's computationally demanding, finite-rate chemistry simulations would have been impractical to produce.



Animation of stable methane combustion. White temperature contours indicate the hottest part of the flame while black indicates cold propellants in the computational fluid dynamics simulation.

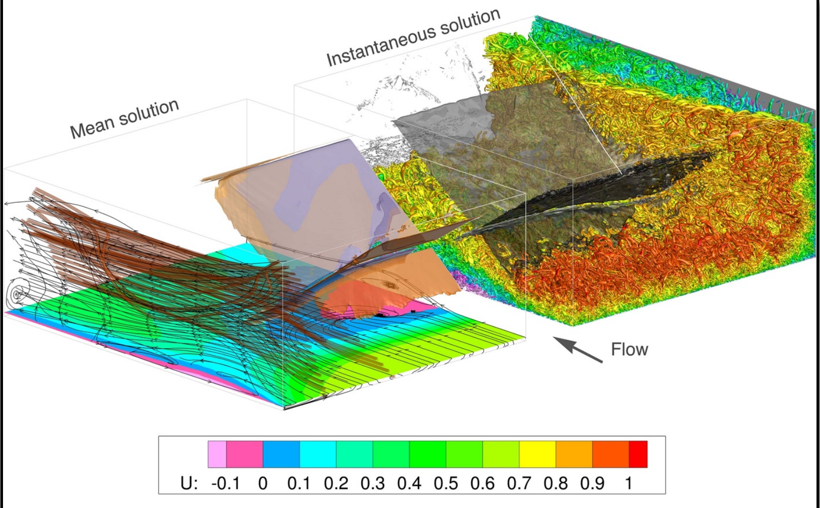
POCs: Brian Richardson, brian.r.richardson@nasa.gov, (256) 544-9396, and Kalen Braman, kalen.e.braman@nasa.gov, (256) 544-8537, NASA Marshall Space Flight Center

Simulations Provide Insight into Shock Wave/Boundary-Layer Interactions*

- Simulations run on the Electra supercomputer are helping researchers understand shock wave/boundary-layer interactions (SBLIs), which occur in aircraft and space vehicles that travel at transonic, supersonic, and hypersonic speeds.
- SBLIs happen when strong pressure waves disrupt near-wall flow, creating excessive unsteady aerothermal loads that can compromise structural integrity, cause component failure, and result in loss of vehicle control surfaces.
  - This is the first application of wall-resolved large-eddy simulation to an impinging SBLI with two sidewalls—critically important for capturing the key physics and reducing the predictive error in the simulation.
  - Results are validated against experimental data to assess the mean velocity and turbulent stress predictions.
- Insight gained from this work will enable wall-resolved large-eddy simulations of complex SBLI configurations and aid development of next-generation turbulence models for faster and more reliable prediction of SBLIs.

** HECC provided supercomputing resources and services in support of this work.*

Mission Impact: This work supports the Aeronautics Research Mission Directorate's Transformational Tools and Technologies Project goal of developing and advancing physics-based tools and methods to reduce the predictive error in SBLI simulations.



Comparison of the mean shock wave solution (left) and instantaneous shock (right). Mean: contours of velocity at y = 1 mm plane with streamlines showing large 3D separation, secondary flow in the corner, and mean shock position. Instantaneous: isosurface of Q-criterion colored by velocity showing eddies in the turbulent boundary layer along the bottom wall and the corner. Separation and thickening of the turbulent boundary layer in the aftermath of the SBLI is evident.

POCs: Manan Vyas, manan.vyas@nasa.gov, (216) 433-6053, NASA Glenn Research Center; Datta Gaitonde, (614) 292-8365, gaitonde.3@osu.edu, The Ohio State University

HECC Facility Hosts Several Visitors and Tours in April 2019

- HECC hosted 14 tour groups in April; guests learned about the agency-wide missions being supported by HECC assets, and also viewed the D-Wave 2000Q quantum system. Visitors this month included:
  - Jaiwon Shin, Associate Administrator for the Aeronautics Research Mission Directorate.
  - James Spann, Acting Chief Scientist, Heliophysics Division at NASA Headquarters, and Chief Scientist, Science and Technology Office at NASA Marshall.
  - Takayuki Kawai, head of Strategic Planning and Industrial Promotion Division, Japan Aerospace.
  - Joseph Klimavicz, Chief Information Officer, Department of Justice, along with Sarah Lynn, Senior Advisor, and Ron Bewtra, Chief Technology Officer.
  - Carl Burleson, Acting Deputy Administrator, Federal Aviation Administration.
  - A group from National Defense University's Eisenhower School for National Security and Research Strategy.
  - A group from the German Federal Ministry of Economic Affairs and Energy, German Aerospace Center, and the German Consulate.
  - A group from the Army Science Board, who were visiting Ames as part of a study for “Battlefield Uses of Artificial Intelligence.”

Cetin Kiris, Computational Aerosciences Branch Chief in the NASA Advanced Supercomputing (NAS) Division, presents to a delegation from the Japan Aerospace Exploration Agency.

POC: Gina Morello, gina.f.morello@nasa.gov, (650) 604-4462, NASA Advanced Supercomputing Division

Papers

- “**Evaluation of Time-Domain Damping Identification Methods for Flutter-Constrained Optimization**,” K. Jacobson, J. Kiviaho, G. Kennedy, M. Smith, Journal of Fluids and Structures, Vol. 87, May 2019 (available online April 1, 2019). *
  https://www.sciencedirect.com/science/article/pii/S0889974618308272
- “**Formulation of Entropy-Stable Schemes for Multicomponent Compressible Euler Equations**,” A. Gouasmi, et al., arXiv:1904.00972 [math.NA], April 1, 2019. *
  htps://arxiv.org/abs/1904.00972
- “**One Solution to the Mass Budget Problem for Planet Formation: Optically Thick Disks with Dust Scattering**,” Z. Zhu, et al., arXiv:1904.02127 [astro-ph.EP], April 3, 2019. *
  https://arxiv.org/abs/1904.02127
- “**A Novel Ten-Moment Multifluid Model for Mercury: From the Planetary Conducting Core to the Dynamic Magnetosphere**,” C. Dong, et al., arXiv:1904.02695 [physics.space-ph], April 4, 2019.
  https://arxiv.org/abs/1904.02695
- “**Bottom-Up Acceleration of Ultra-High-Energy Cosmic Rays in the Jets of Active Galactic Nuclei**,” R. Mbarek, D. Caprioli, arXiv:1904.02720 [astro-ph.HE], April 4, 2019. *
  https://arxiv.org/abs/1904.02720
- “**Testing the Impact Heating Hypothesis for Early Mars with a 3D Global Climate Model**,” K. Steakley, et al., Icarus (accepted publication), April 7, 2019. *
  https://www.sciencedirect.com/science/article/pii/S0019103518306651

** HECC provided supercomputing resources and services in support of this work*

Papers (cont.)

- “**Long-Term Variations in the Pixel-to-Pixel Variability of NOAA AVHRR SST Fields from 1982 to 2015**,” F. Wu, et al., Remote Sensing, Vol. 11, Issue 7, April 8, 2019. *
https://www.mdpi.com/2072-4292/11/7/844
- “**Convection in Thin Shells of Icy Satellites: Effects of Latitudinal Surface Temperature Variations**,” M. Weller, L. Fuchs, T. Becker, K. Soderlund, Journal of Geophysical Research: Planets, April 9, 2019. *
https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2018JE005799
- “**Inference of Meteoroid Characteristics Using a Genetic Algorithm**,” A. Tarano, L. Wheeler, S. Close, D. Mathias, Icarus, Vol. 329, April 10, 2019. * 103518305669
- “**A Reassessment of North American River Basin Cool-Season Precipitation: Developments From a New Mountain Climatology Data Set**,” M. Wrzesien, M. Durand, T. Pavelsky, Water Resources Research, April 11, 2019. *
https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2018WR024106
- “**Search for Gamma-Ray Emission from p-wave Dark Matter Annihilation in the Galactic Center**,” C. Johnson, et al., arXiv:1904.06261 [astro-ph.HE], April 12, 2019. *
https://arxiv.org/abs/1904.06261
- “**AUSM Scheme: Its Application to a Realistic Combustion Configuration, the Energy Efficient Engine**,” K. Miki, J. Moder, M.-S. Liou, Shock Waves, April 12, 2019. *
https://link.springer.com/article/10.1007/s00193-019-00897-0

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Papers (cont.)

- "**Studying Dawn-Dusk Asymmetries of Mercury's Magnetotail Using MHD-EPIC Simulations**," Y. Chen, et al., arXiv:1904.06753 [physics.space-ph], April 14, 2019. *
https://arxiv.org/abs/1904.06753
- "**TESS Delivers Its First Earth-sized Planet and a Warm Sub-Neptune**," D. Dragomir, et al., The Astrophysical Journal Letters, Vol. 875, No. 2, April 15, 2019. *
https://iopscience.iop.org/article/10.3847/2041-8213/ab12ed/meta
- "**Breezing Through the Space Environment of Barnard's Star b**," D. Alvarado-Gomez, et al., The Astrophysical Journal Letters, Vol. 875, April 20, 2019. *
https://iopscience.iop.org/article/10.3847/2041-8213/ab1489/
- "**Tracing Black Hole and Galaxy Co-Evolution in the Romulus Simulations**," A. Ricarte, et al., arXiv:1904.10116 [astro-ph.GA], April 23, 2019. *
https://arxiv.org/abs/1904.10116
- "**Search for γ-ray Emission from Dark Matter Particle Interactions from Andromeda and Triangulum Galaxies with the Fermi Large Area Telescope**," M. Di Mauro, et al., arXiv:1904.10977 [astro-ph.HE], April 24, 2019. *
https://arxiv.org/abs/1904.10977
- "**Multi-Filament Inflows Fueling Young Star Forming Galaxies**," D. C. Martin, et al., arXiv:1904.11465 [astro-ph.GA], April 25, 2019. *
https://arxiv.org/abs/1904.11465

** HECC provided supercomputing resources and services in support of this work*

Papers (cont.)

- “**Slowdown in Antarctic mass loss from solid Earth and sea-level feedbacks**,” E. Larour, et al., Science, April 25, 2019. *
https://science.sciencemag.org/content/early/2019/04/24/science.aav7908
- “**Aerodynamic Load Control for Multi-Element Airfoils Using Surface-Normal Trailing-Edge Blowing**,” S. Hosseini, C. van Dam, S. Pandya, Journal of Aircraft, published online April 26, 2019. *
https://arc.aiaa.org/doi/full/10.2514/1.C035248

** HECC provided supercomputing resources and services in support of this work*

Presentations

- **2019 IAA Planetary Defense Conference**, Washington DC, April 29-May 3, 2019.
  - “**Atmospheric Injections from Impacts of Kilometer Scale Asteroids**,” D. Robertson.*
  - “**Strength and Breakup Factors in Impact Scenario Risk Assessment**,” L. Wheeler.*
  - “**Next Steps in Impact Risk Assessment**,” D. Mathias.*

** HECC provided supercomputing resources and services in support of this work*

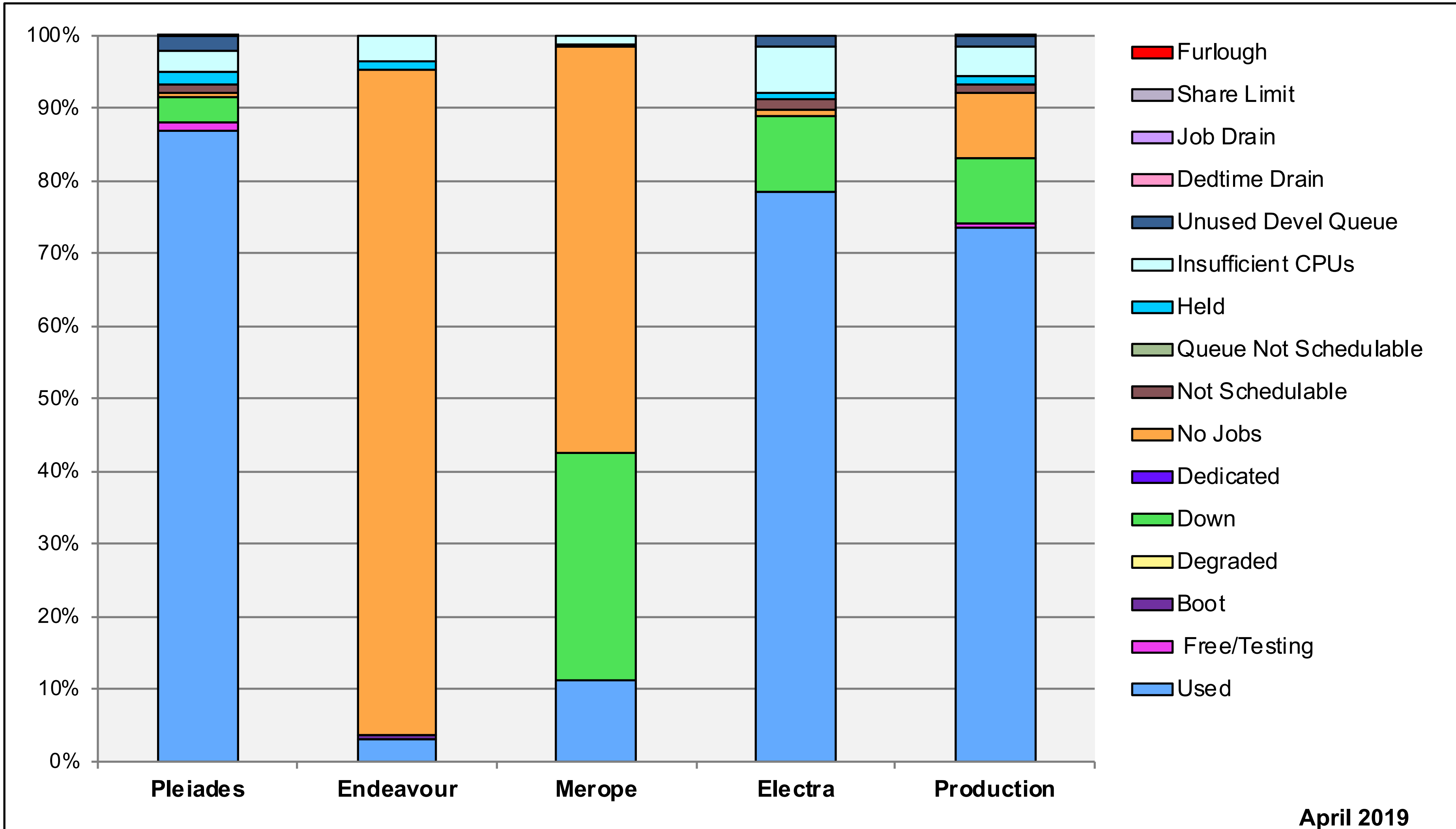
News and Events

- **Spacetime Simulations and the Discovery of Gravitational Waves**, *NAS Feature*, April 18, 2019—Simulations run on NASA supercomputers and stunning visualizations by the NAS team were key to the research leading to the first-ever gravitational wave detection. https://www.nas.nasa.gov/publications/articles/feature_gravitational_waves_Centrella.html
  - **Spacetime Simulations and the Discovery of Gravitational Waves**, *NASA Ames Astrogram 2019.* https://www.nasa.gov/feature/nasa-ames-astrogram-april-2019
- **NASA Researcher on the Driving Force Behind Aerospace Innovation**, *Elsevier*, April 30, 2019—Marie Denison, a research scientist in the NASA Advanced Supercomputing (NAS) Division, talks about her work in computational physics and the importance of research collaboration. Denison will be a speaker at the Women of Silicon Valley event May 2–3, 2019 in San Francisco, California. https://www.elsevier.com/connect/nasa-researcher-on-the-driving-force-behind-aerospace-innovation?sf211856837=1

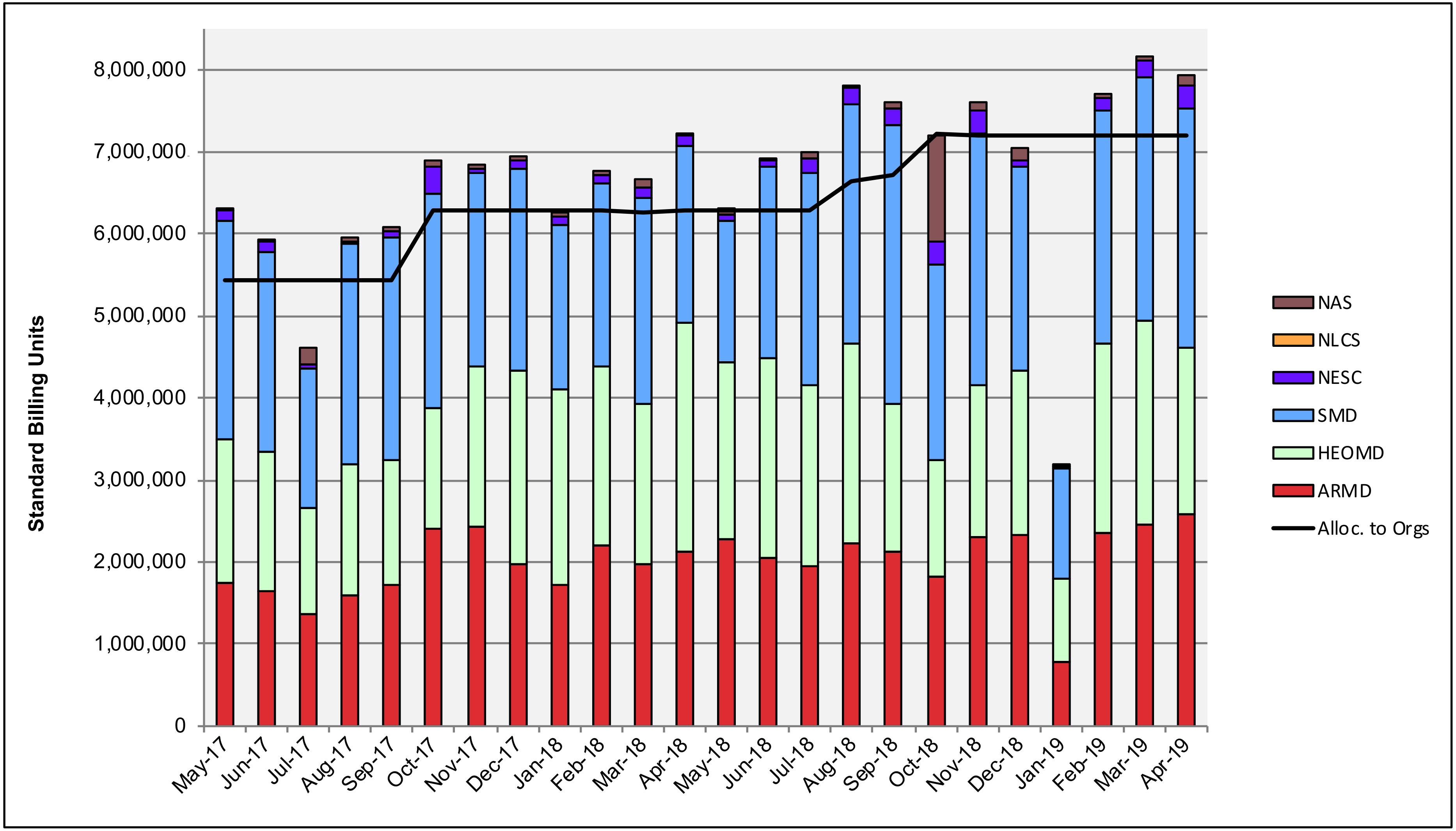
News and Events: Social Media

- **Agency Coverage of NAS Computing**
  - NASA Supercomputing coverage of OVERFLOW NASA SpinOff article (NAS):
    - Twitter: 181 retweets, 816 likes
    - Facebook: 420 users reached, 24 engagements
  - NASA Supercomputing coverage of Scientific Visualization Studio Earth models (NCCS):
    - Twitter: 4 retweets, 13 likes
    - Facebook: 576 users reached, 52 engagements
- **Top Posts from NAS**
  - Black Hole Merger/Gravitational Wave Feature Story:
    - Twitter: 7 retweets, 11 likes
    - Twitter (ICYMI): 1 retweet, 2 likes
    - Facebook: 762 users reached, 73 engagements
  - Participation in NASA's #EarthDay Campaign:
    - Twitter: 5 retweets, 11 likes
  - Participation in NASA's #PlanetaryDefense Campaign:
    - Twitter: 6 retweets, 15 likes

HECC Utilization



HECC Utilization Normalized to 30-Day Month



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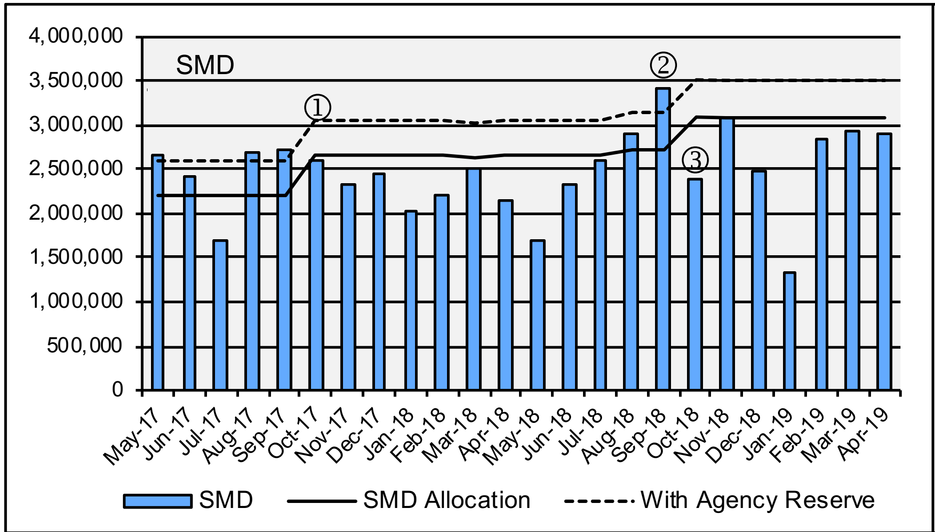
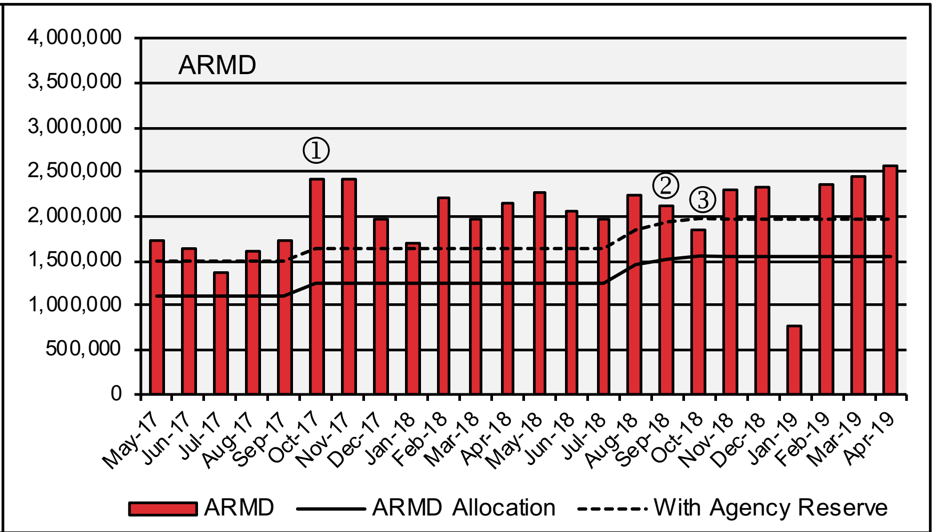
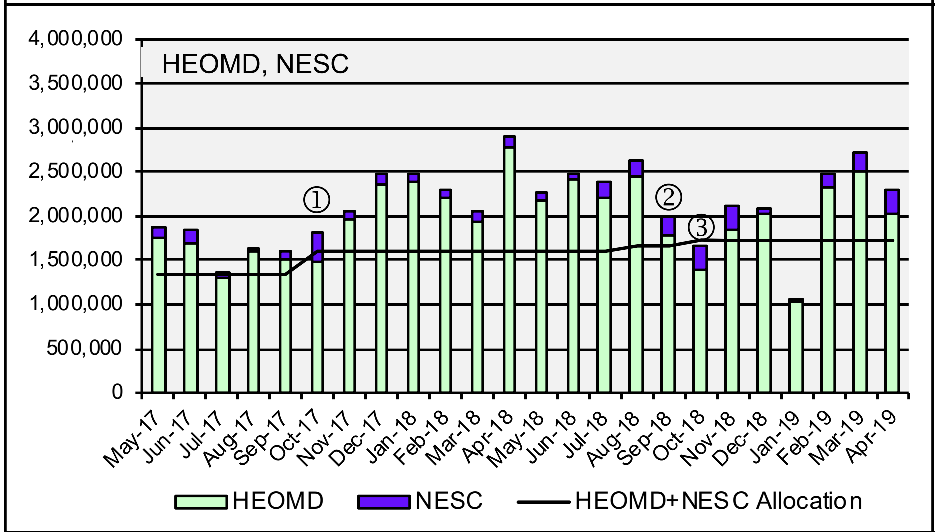




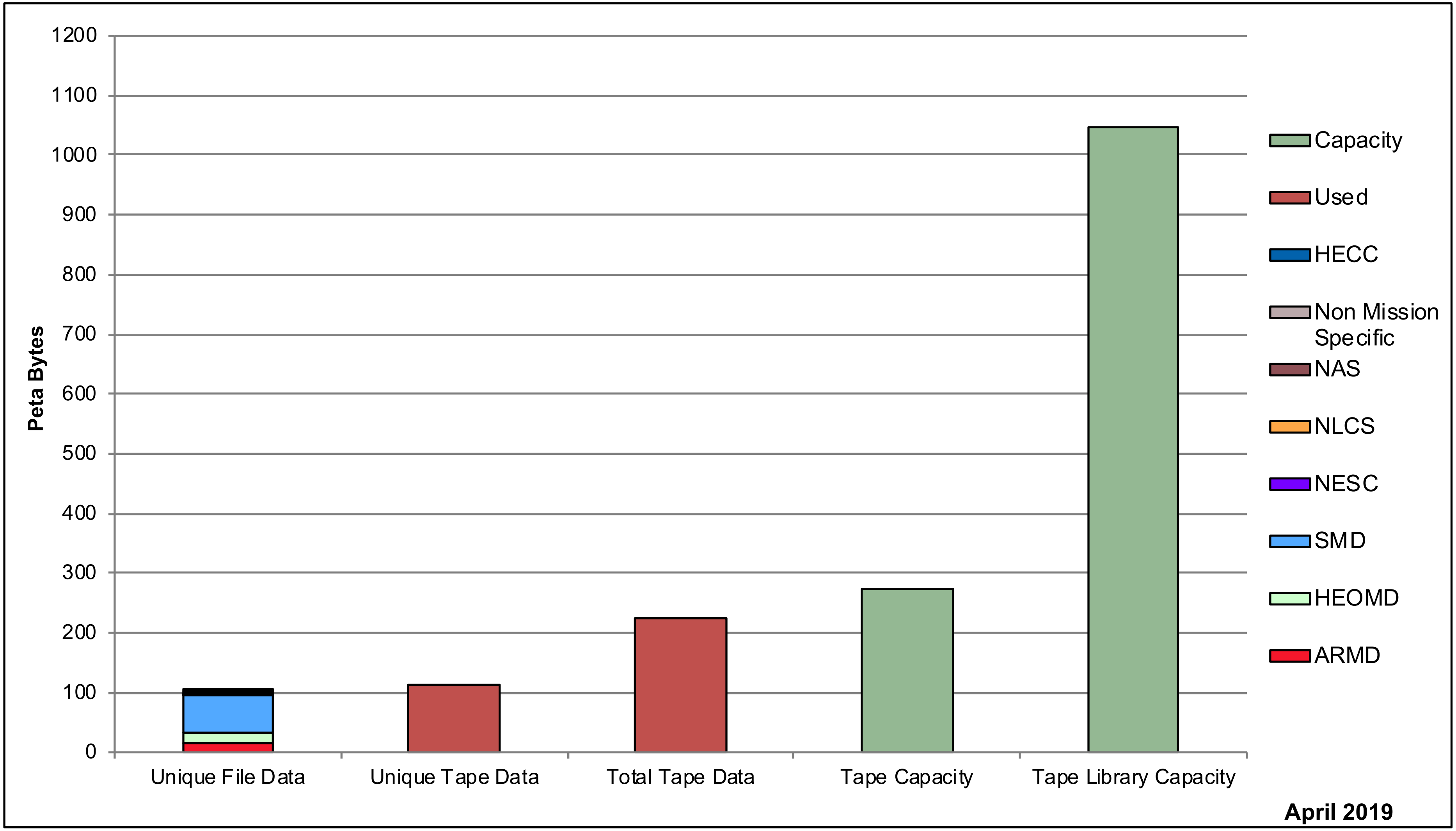


① 4 Skylake E cells (16 D Rack Equivalence) added to Electra

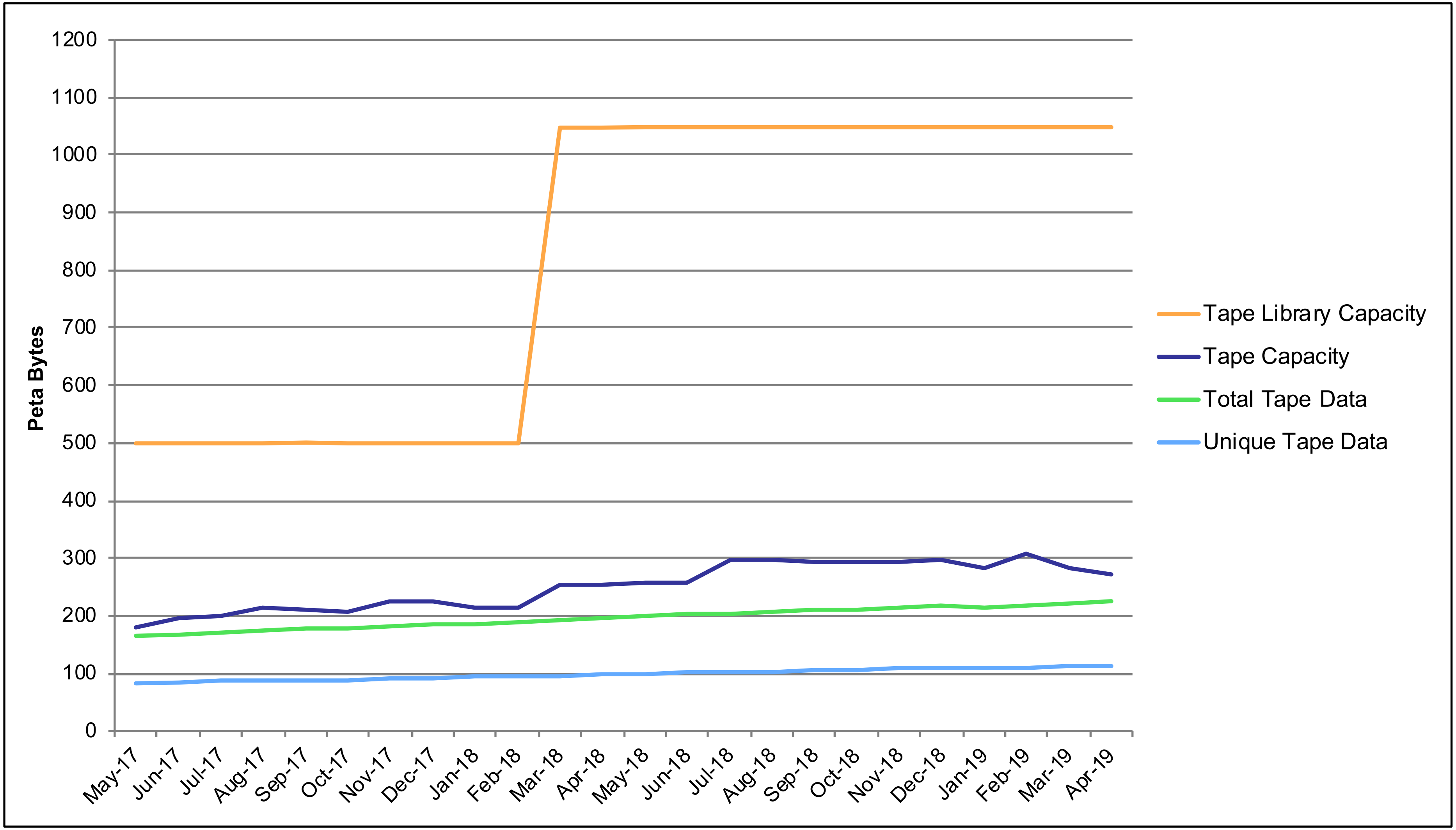
② 2 Skylake E cells (8 D Rack Equivalence) added to Electra; 1 rack is dedicated to ARMD

③ 2 Skylake E cells (8 D Rack Equivalence) added to Electra; 1 rack is dedicated to SMD

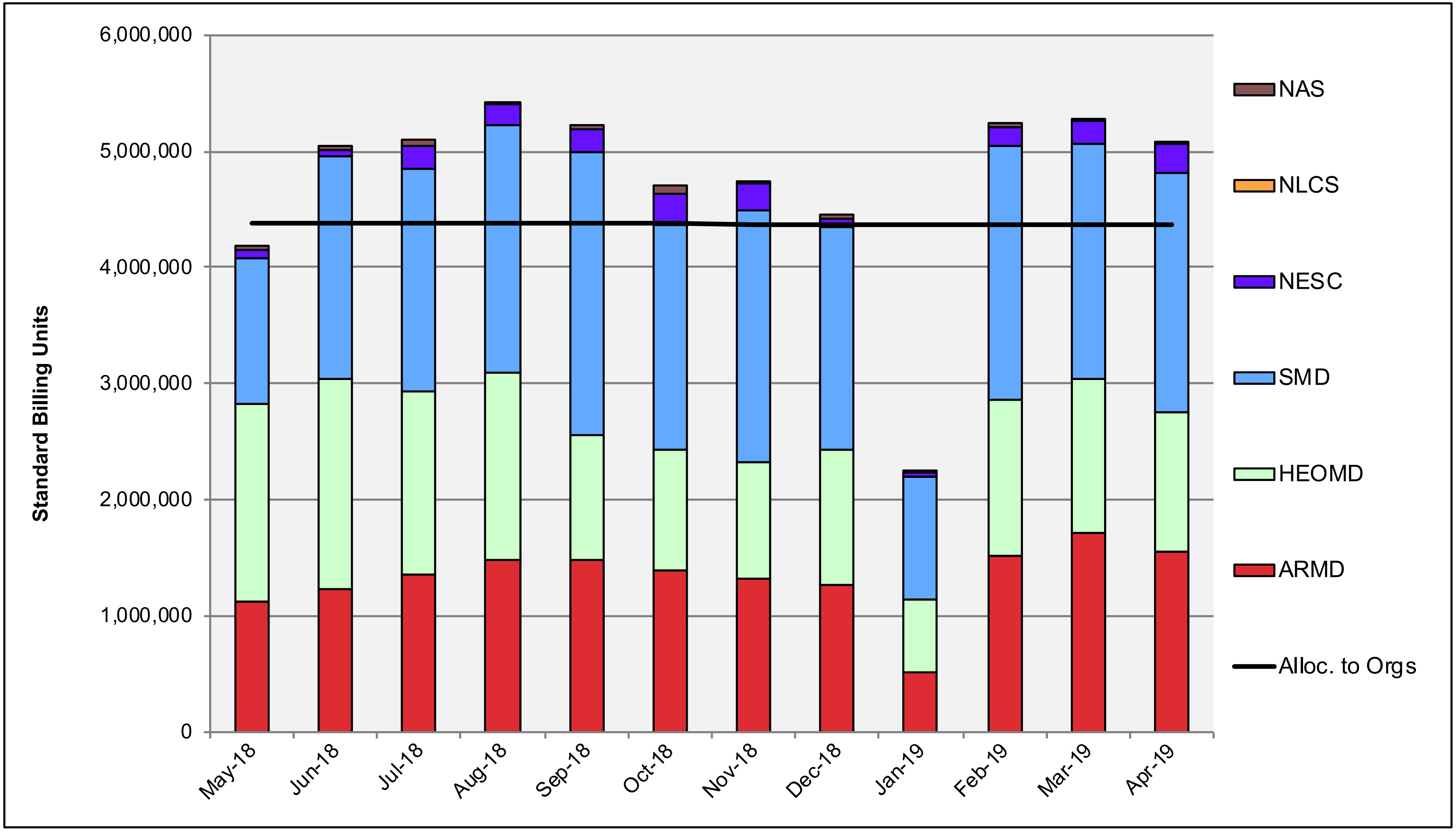
Tape Archive Status



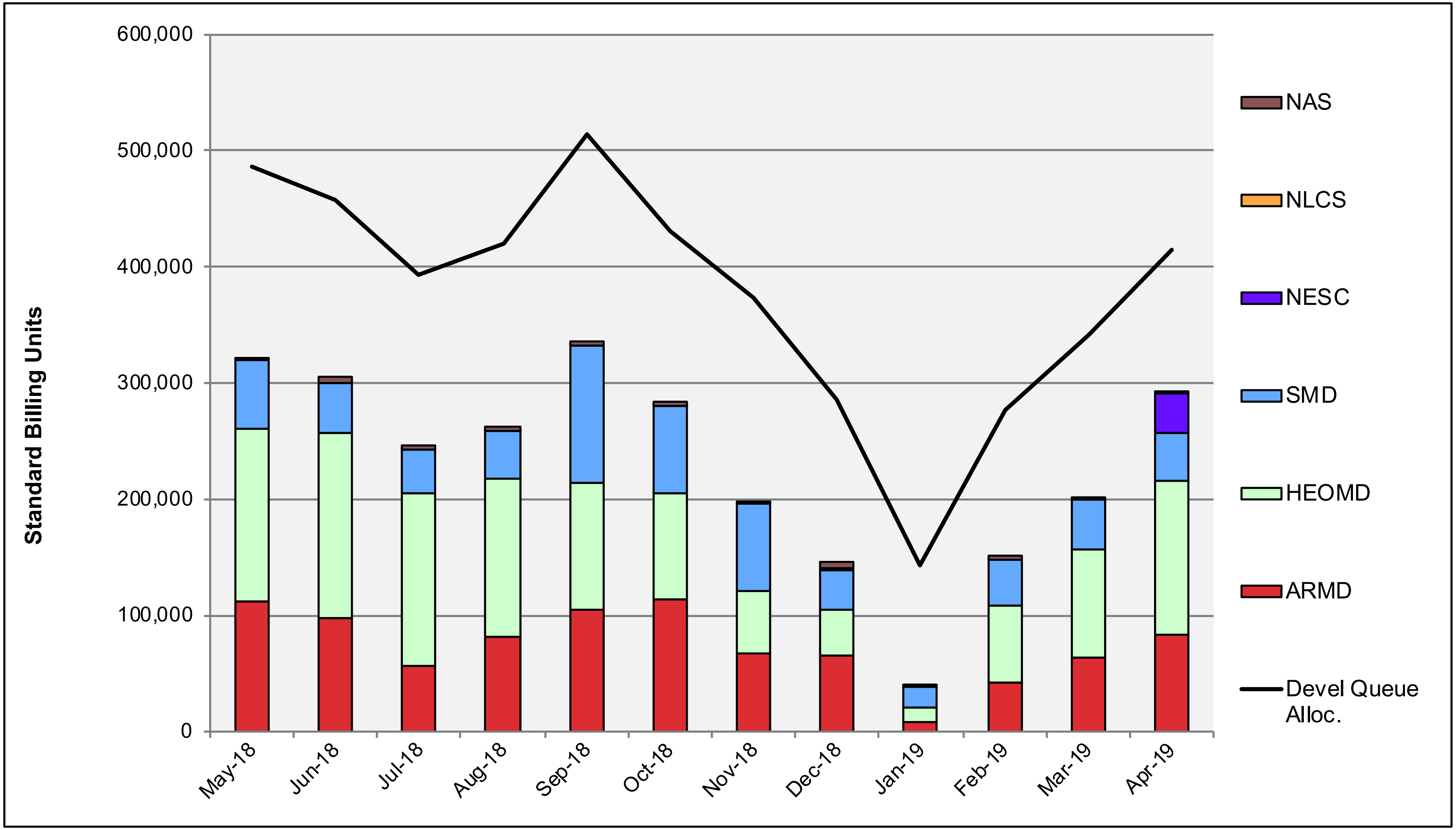
Tape Archive Status



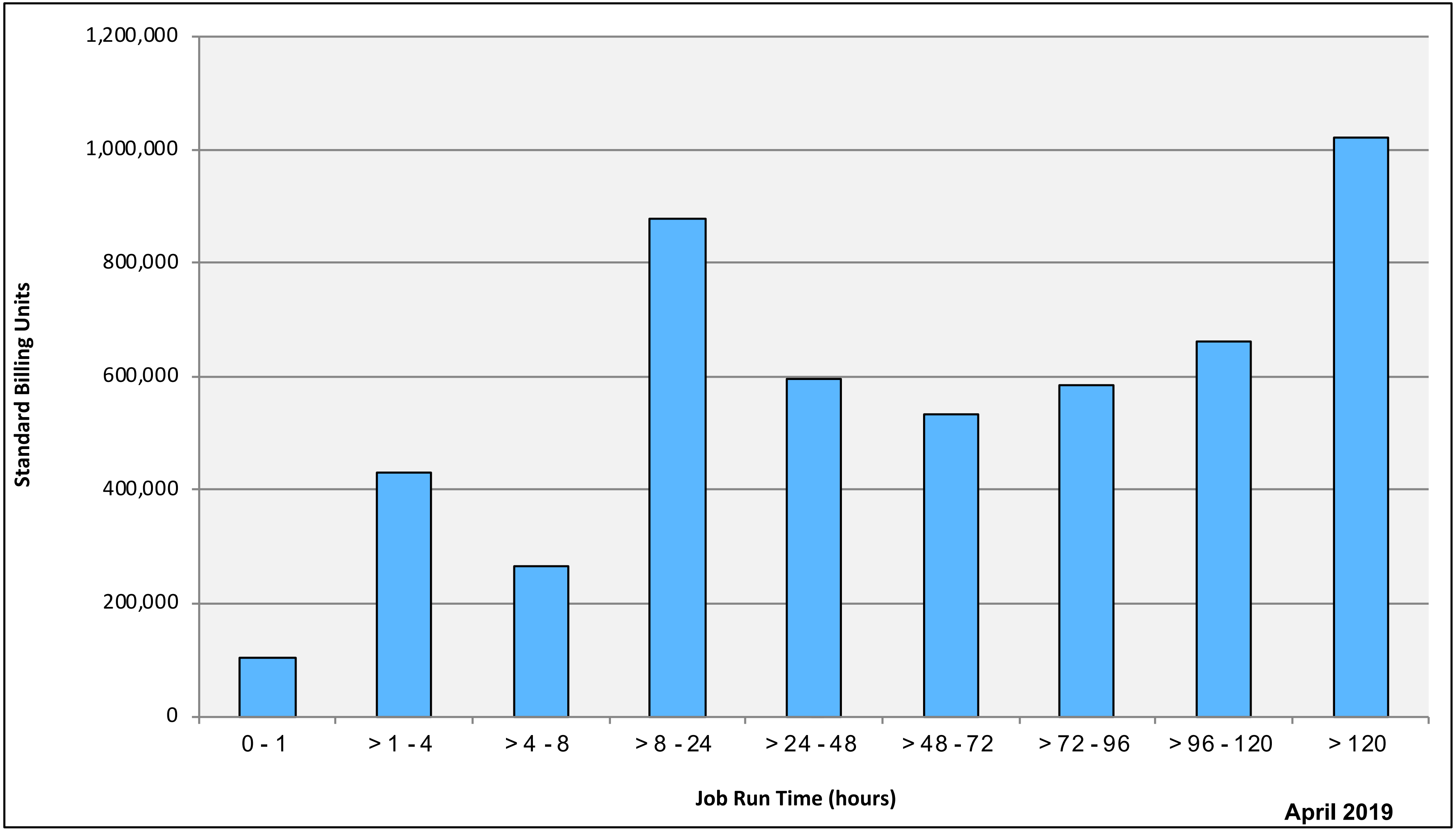
Pleiades: SBUs Reported, Normalized to 30-Day Month



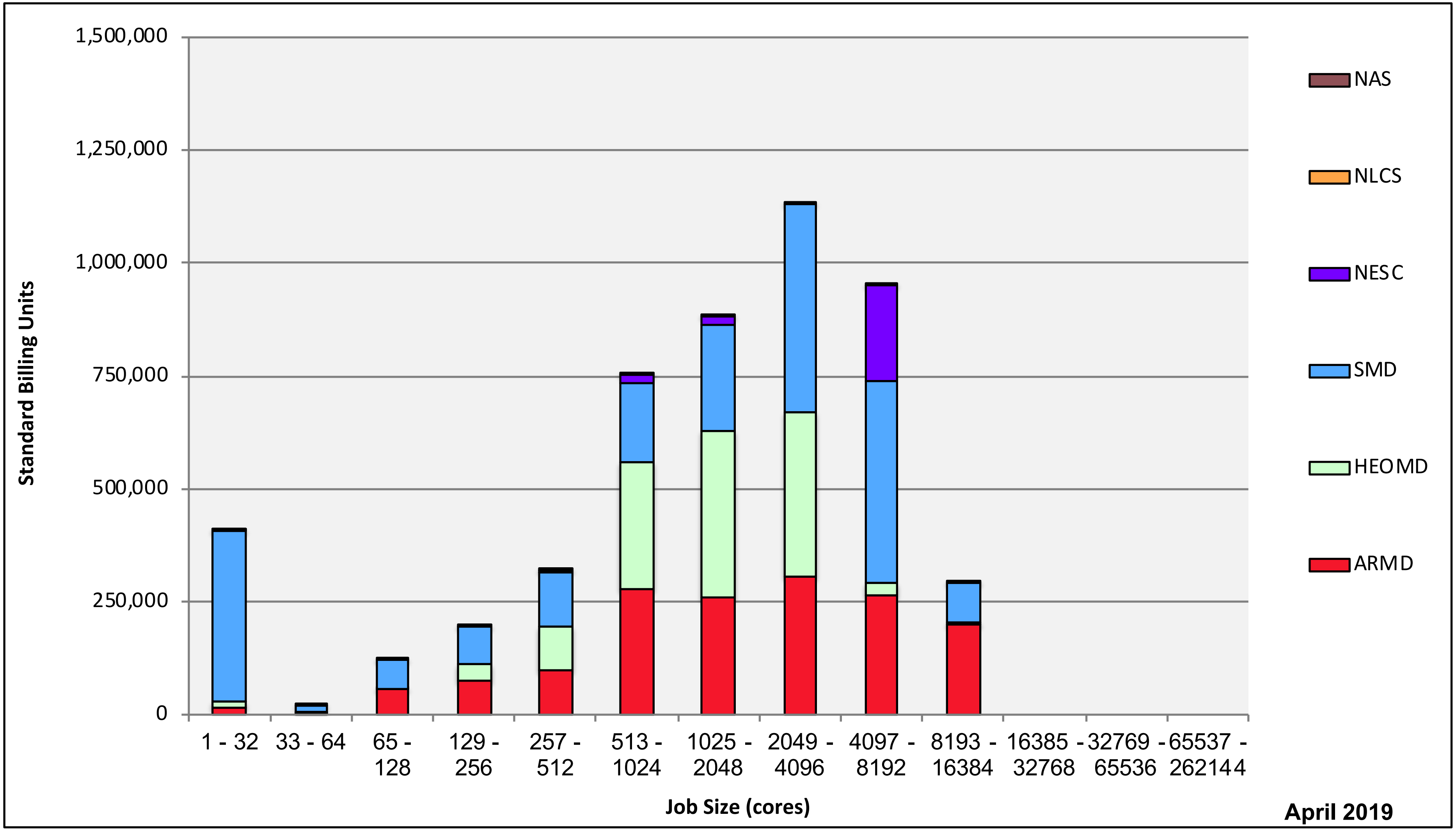
Pleiades:
Devel Queue Utilization



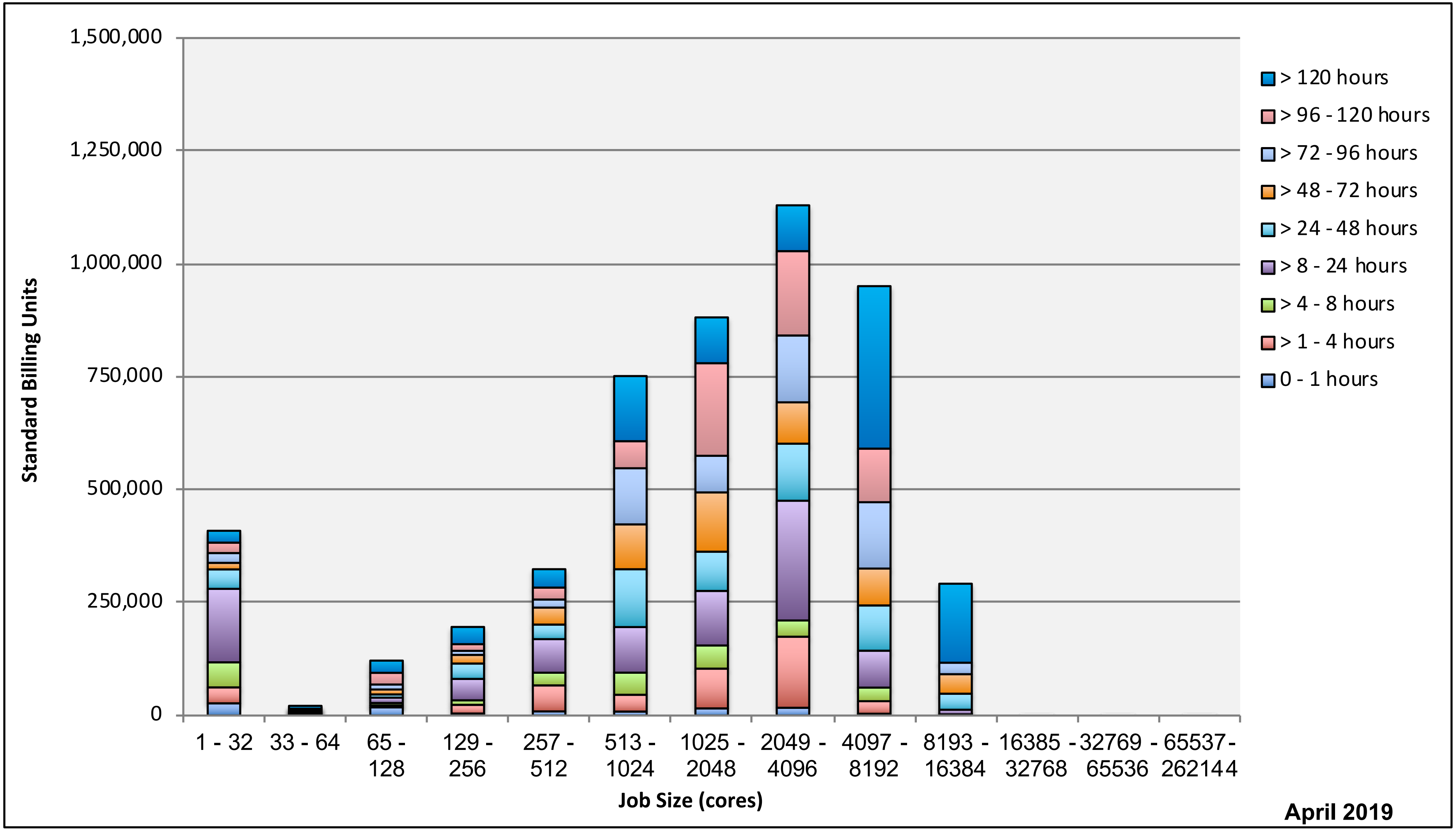
Pleiades:
Monthly Utilization by Job Length



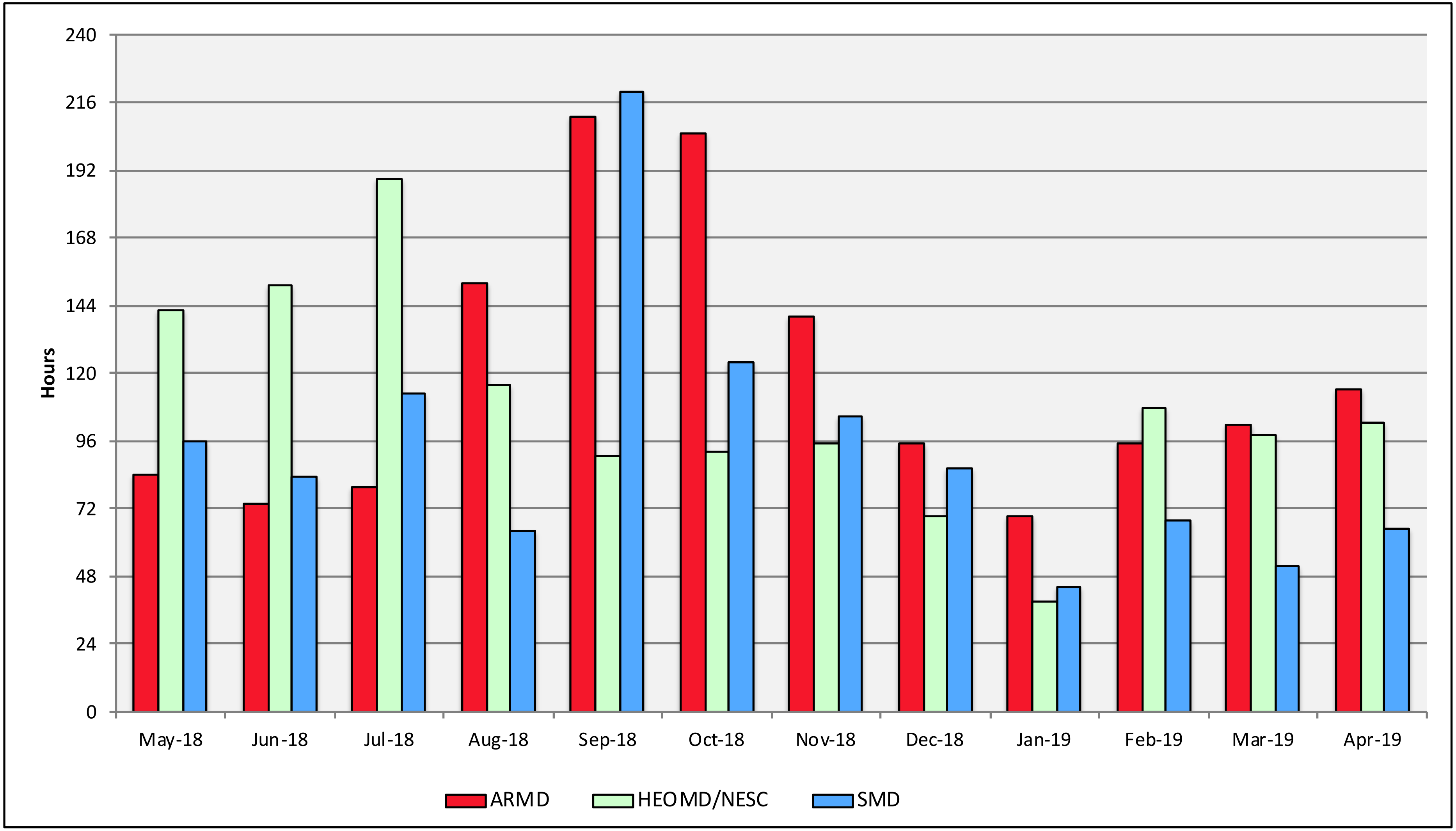
Pleiades: Monthly Utilization by Size and Mission



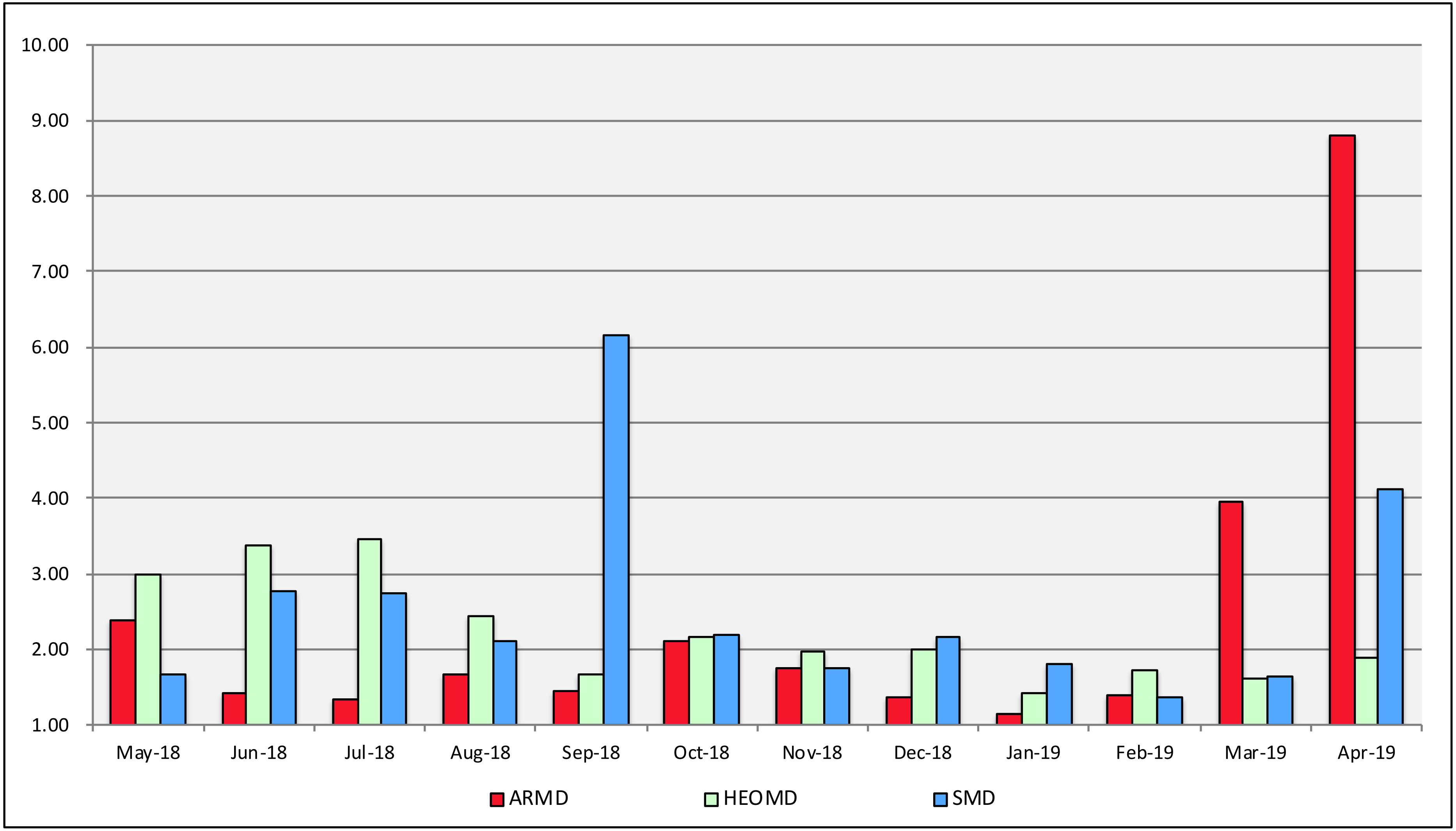
Pleiades: Monthly Utilization by Size and Length



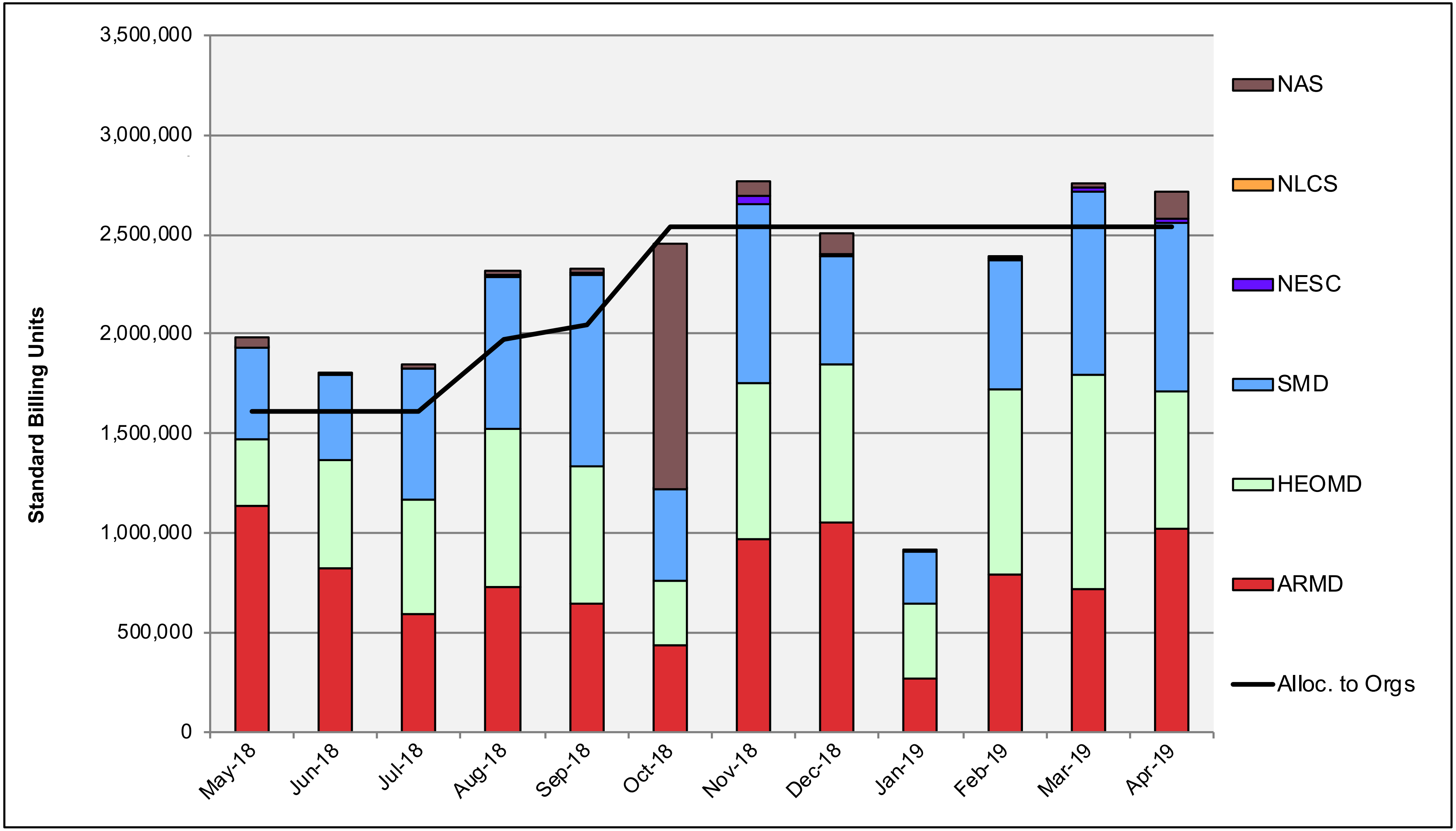
Pleiades:
Average Time to Clear All Jobs



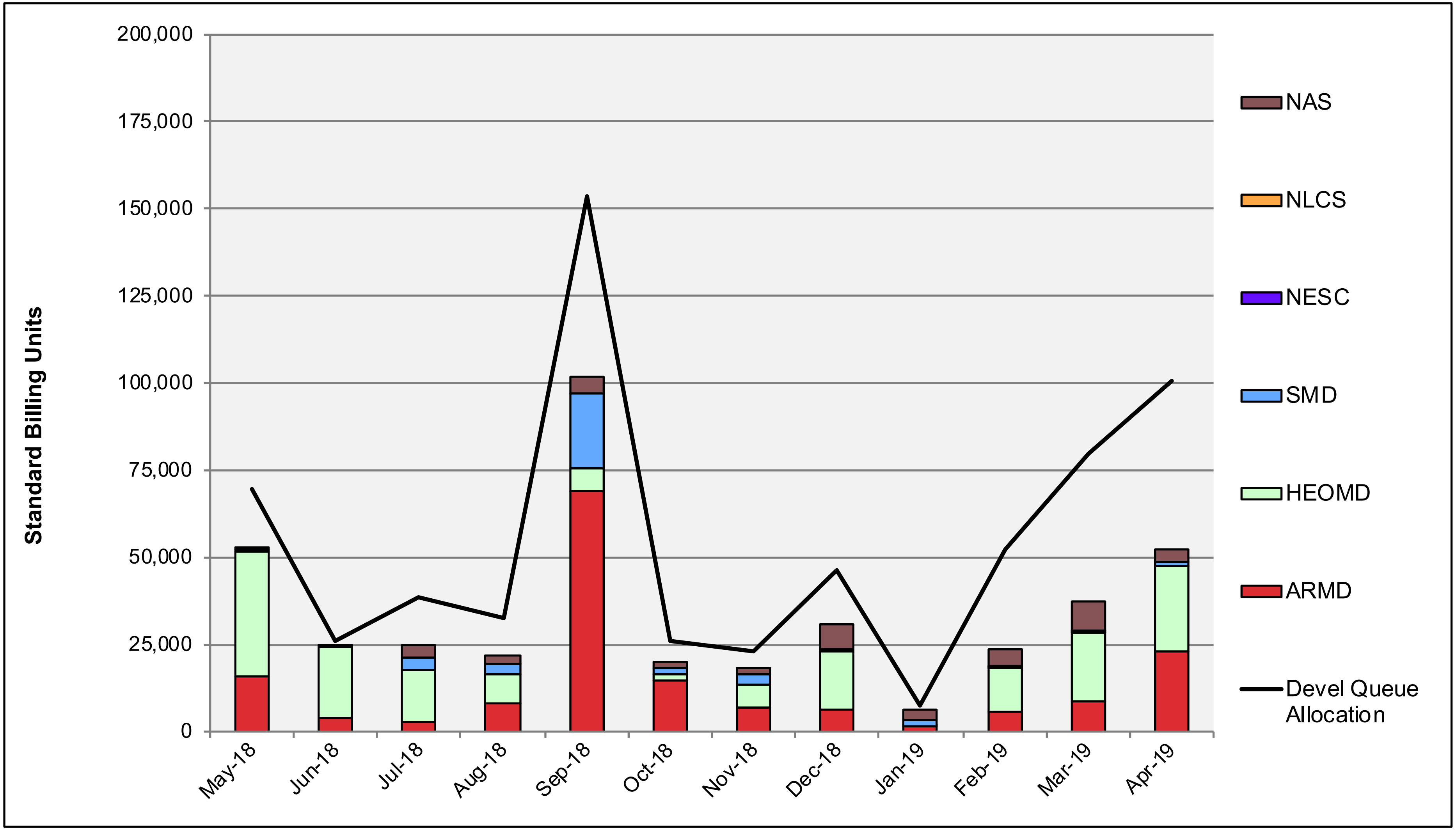
Pleiades: Average Expansion Factor



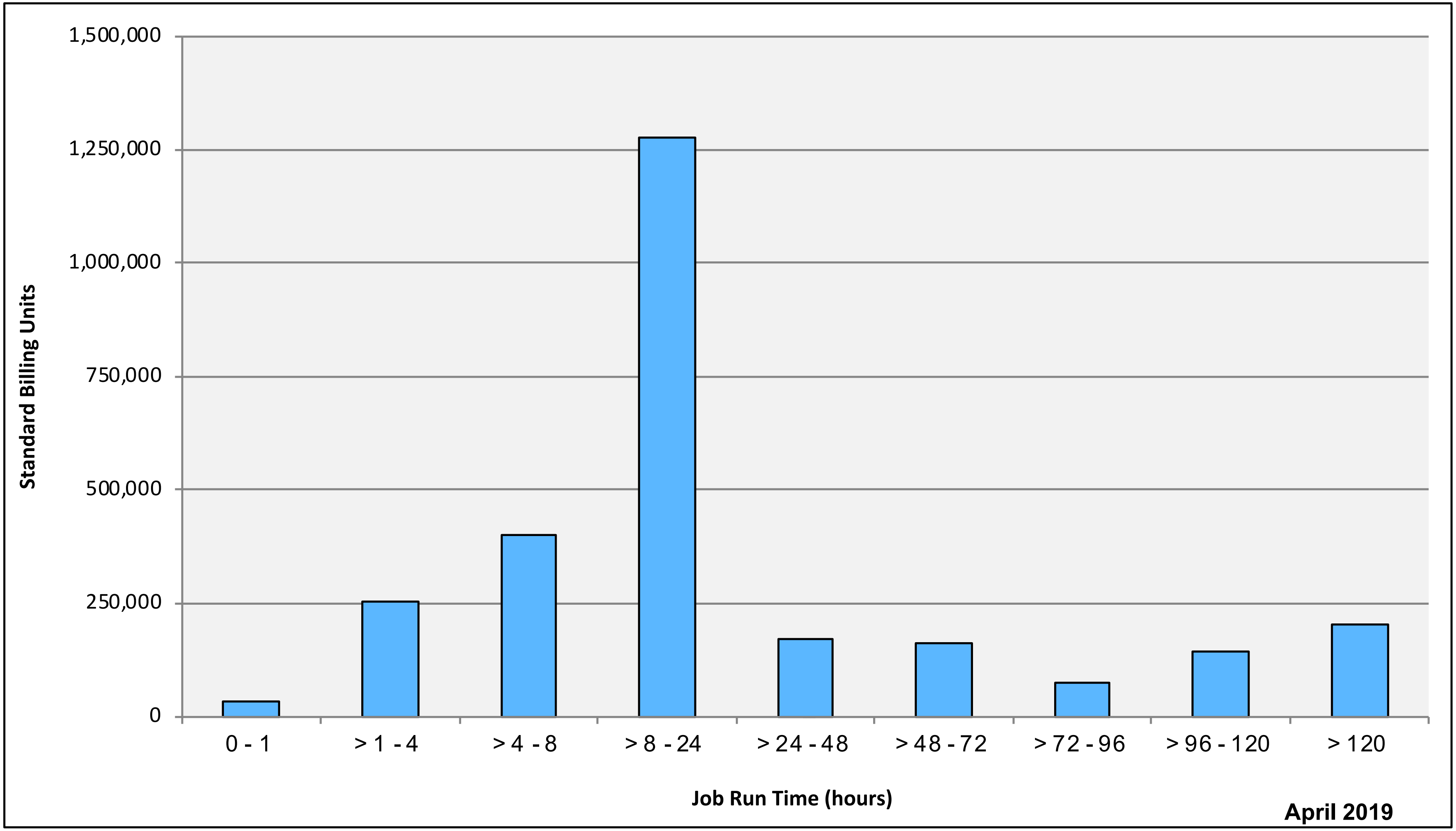
Electra: SBUs Reported, Normalized to 30-Day Month



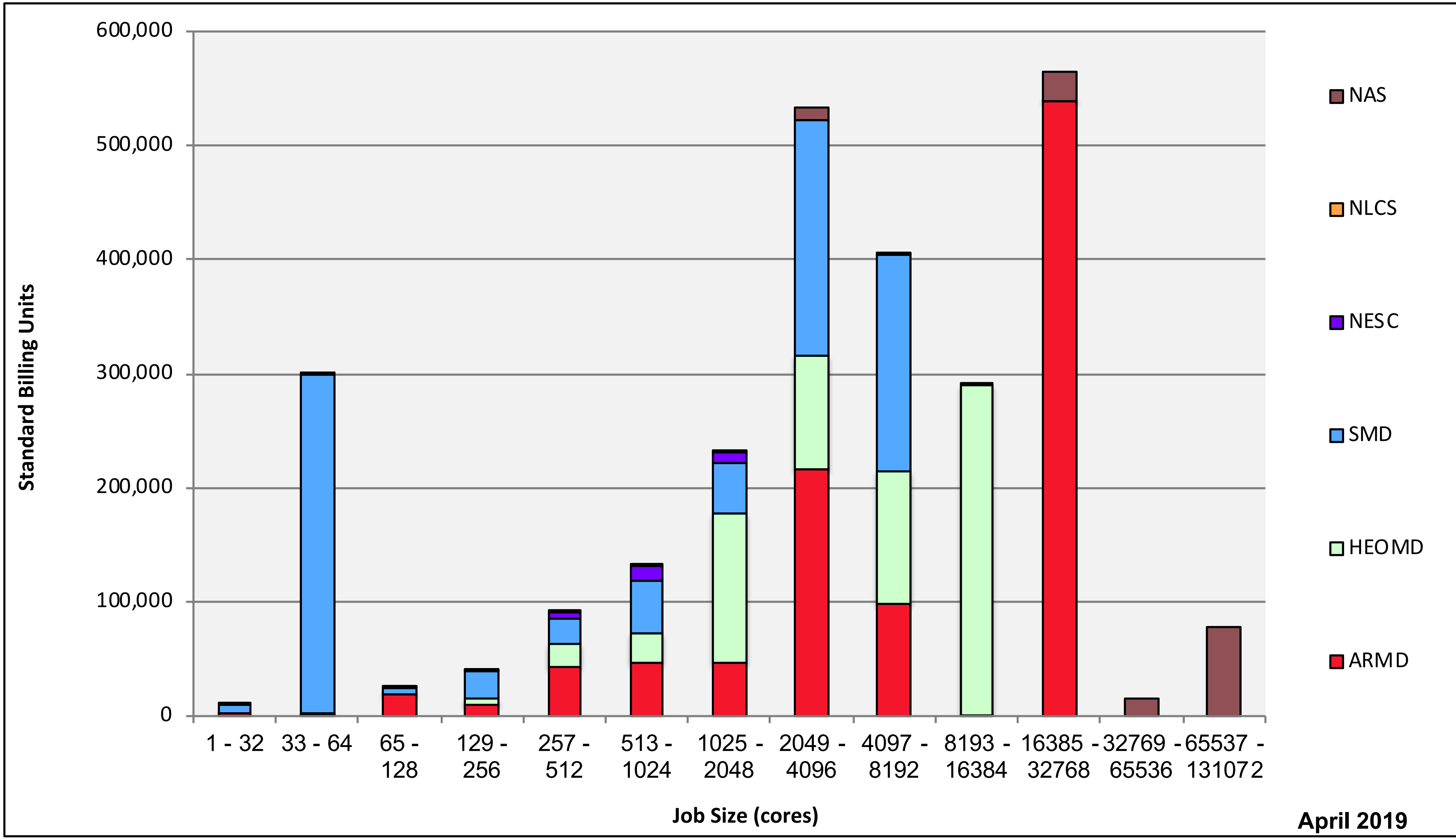
Electra:
Devel Queue Utilization



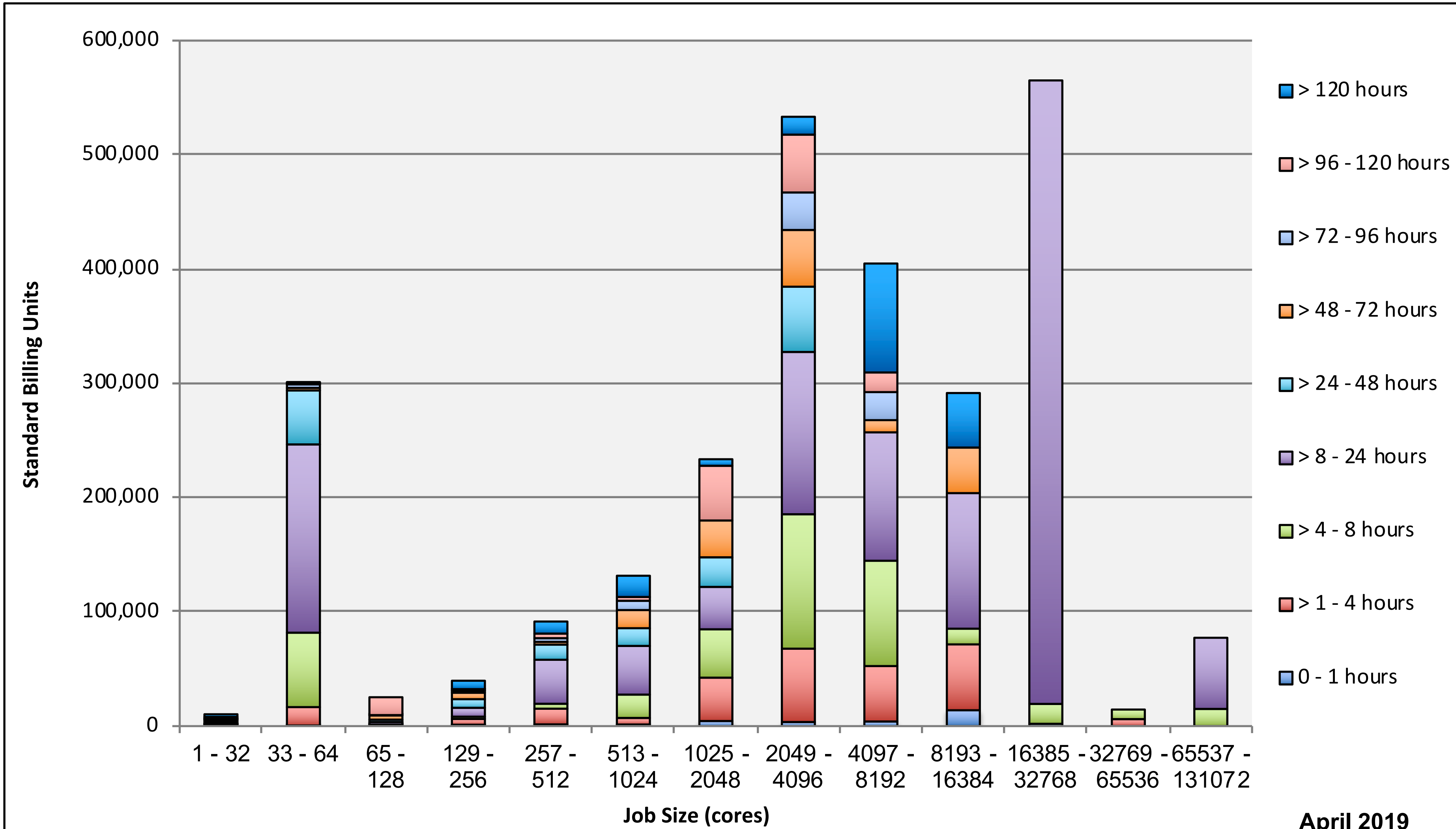
Electra: Monthly Utilization by Job Length



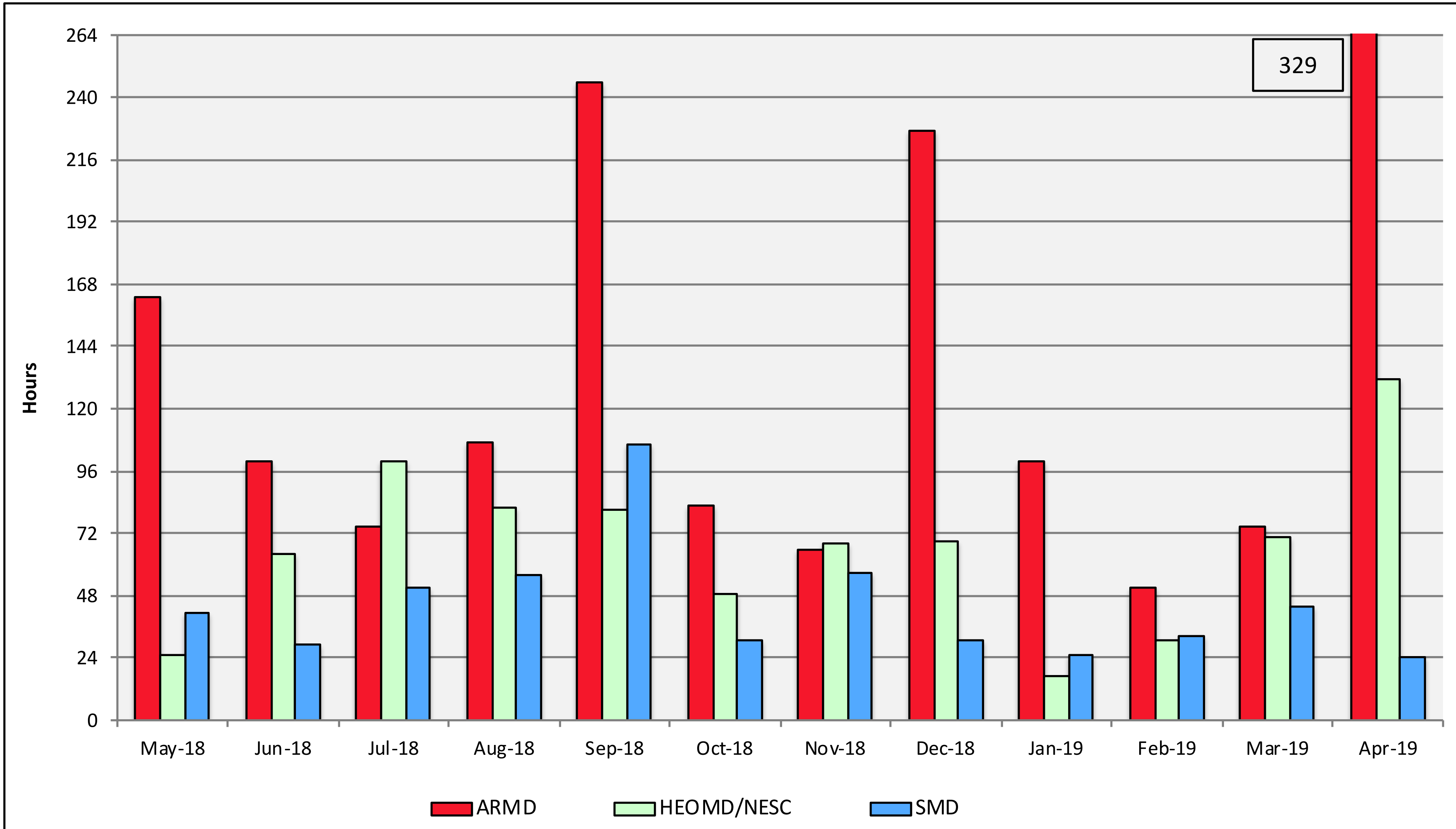
Electra:
Monthly Utilization by Size and Mission



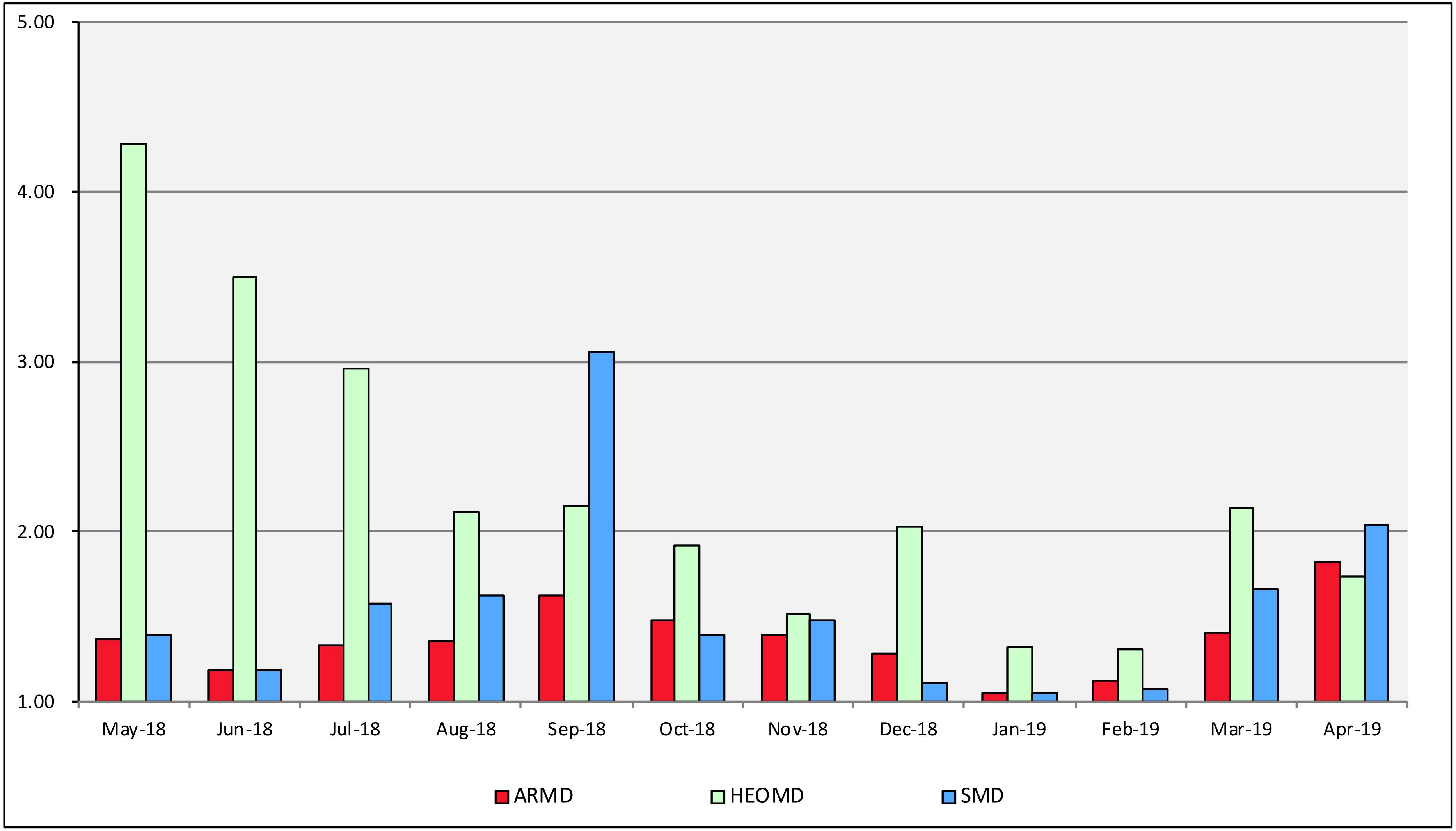
Electra: Monthly Utilization by Size and Length



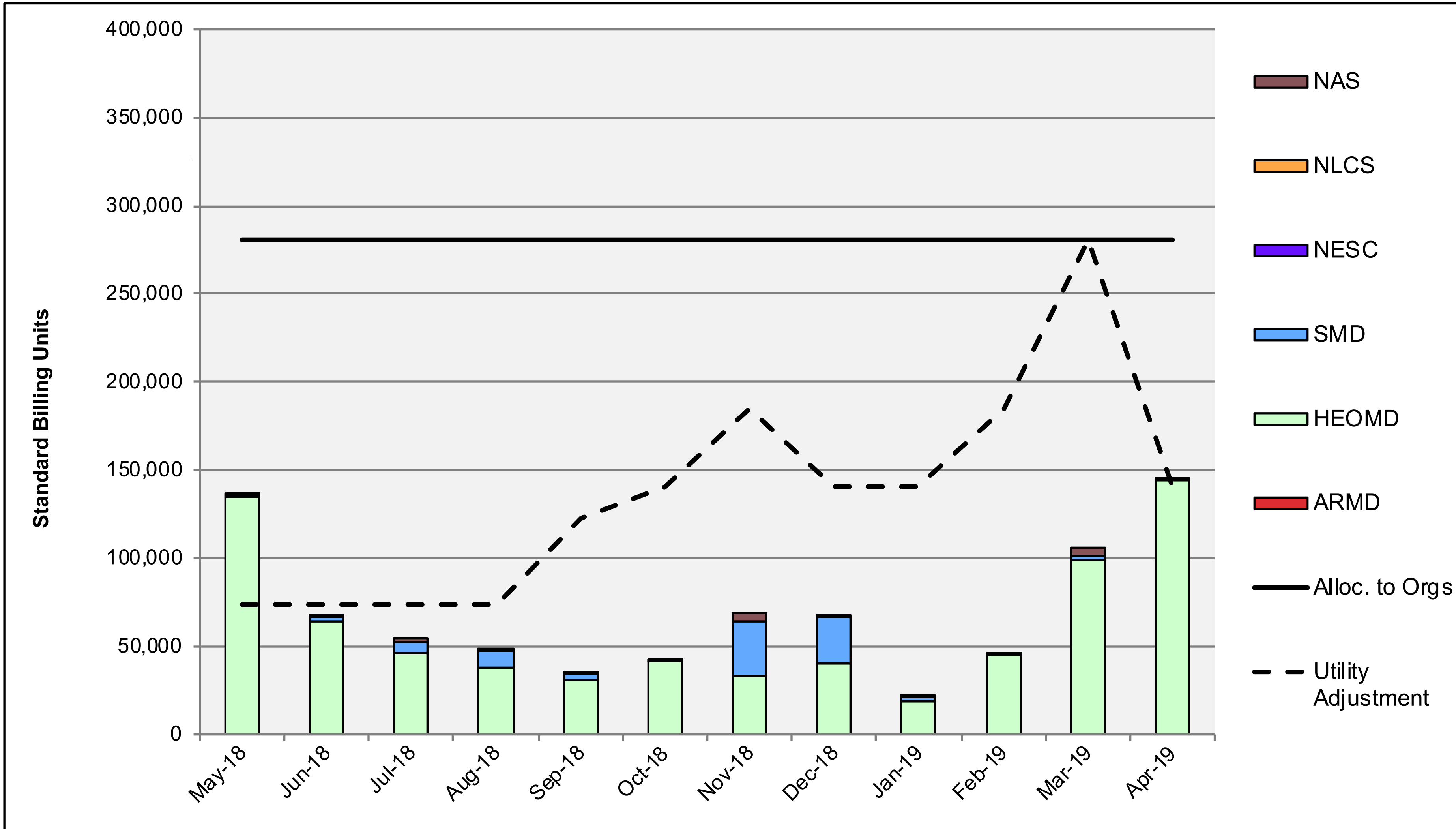
Electra: Average Time to Clear All Jobs



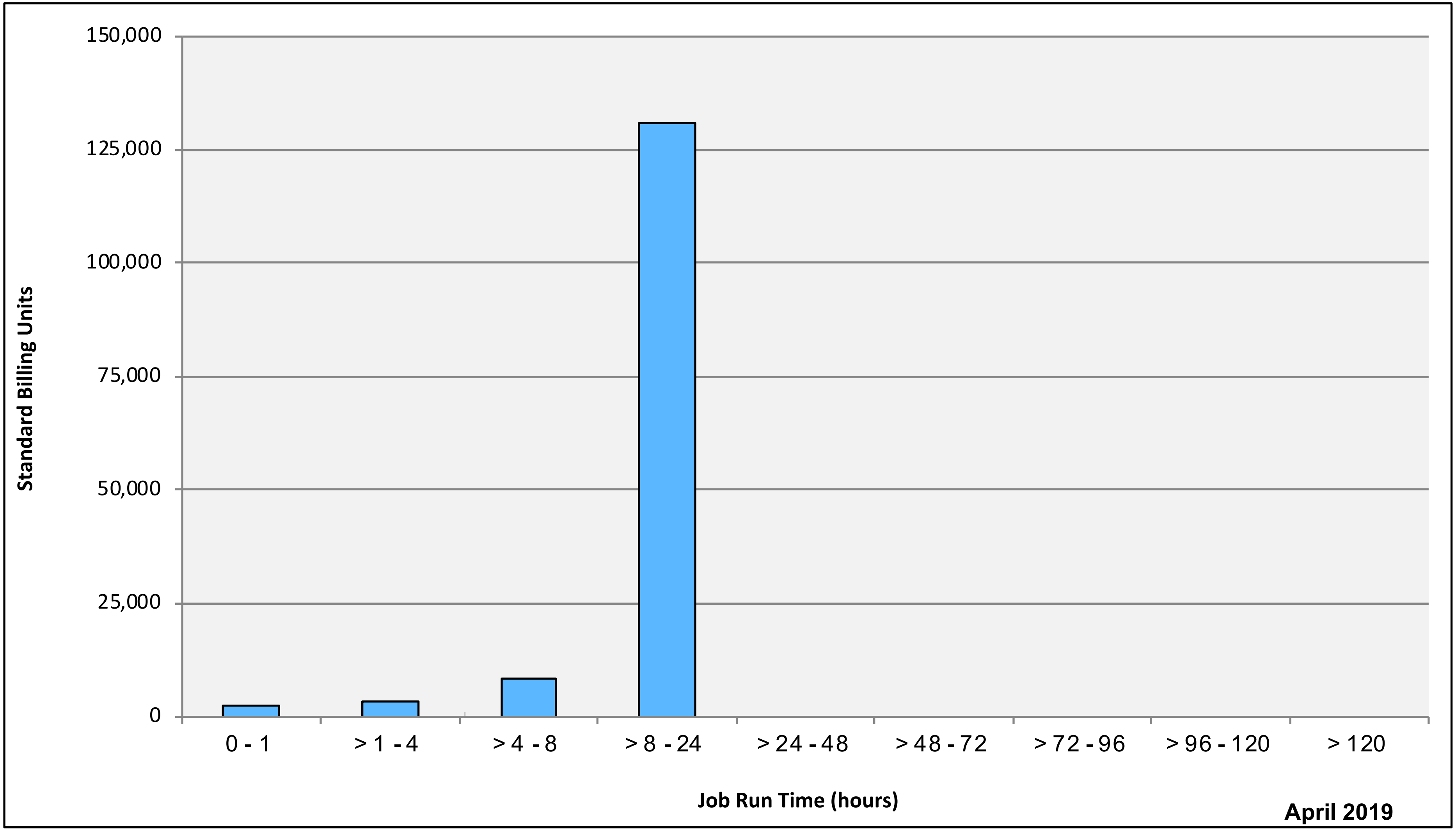
Electra:
Average Expansion Factor



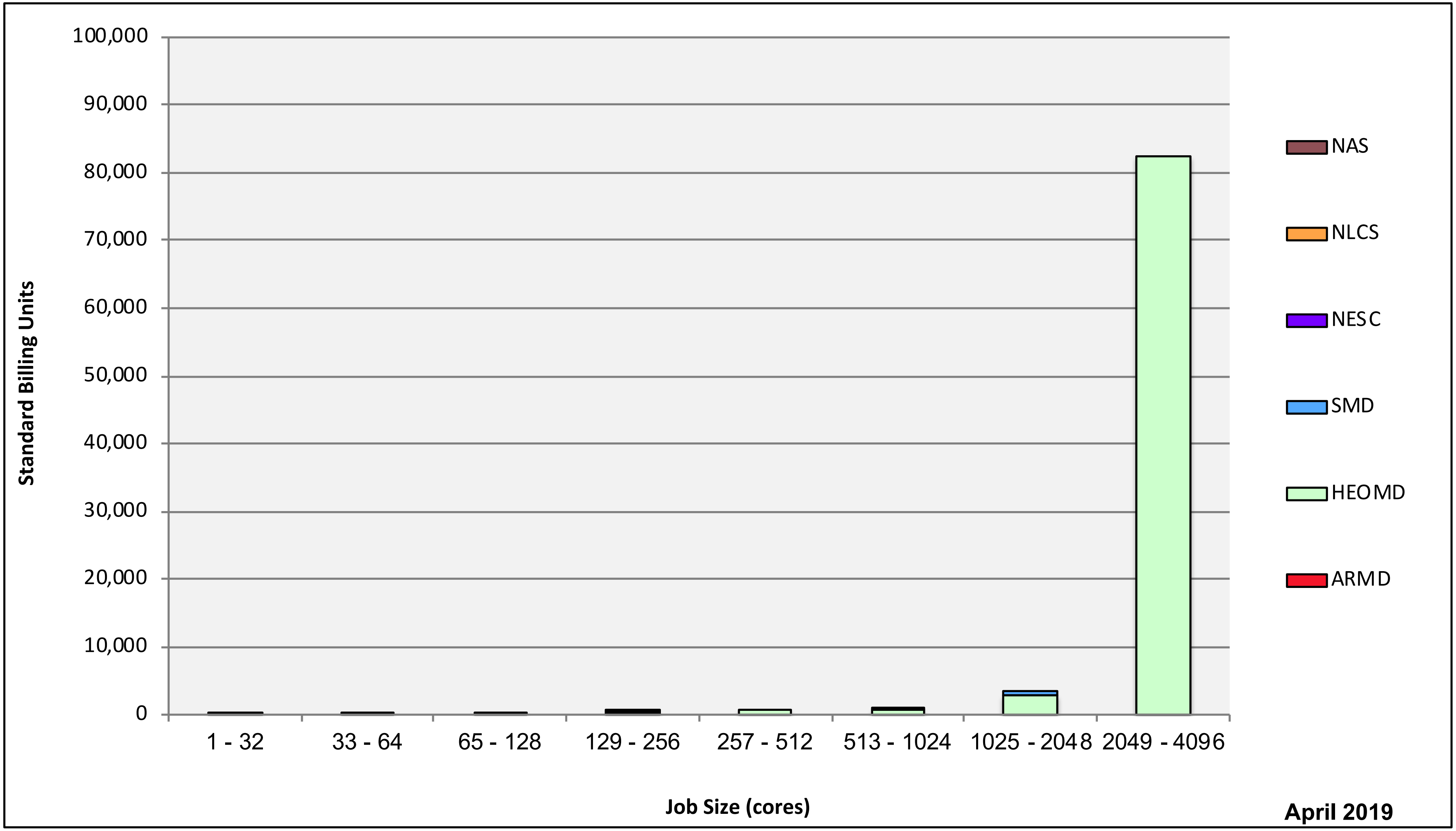
Merope:
SBUs Reported, Normalized to 30-Day Month



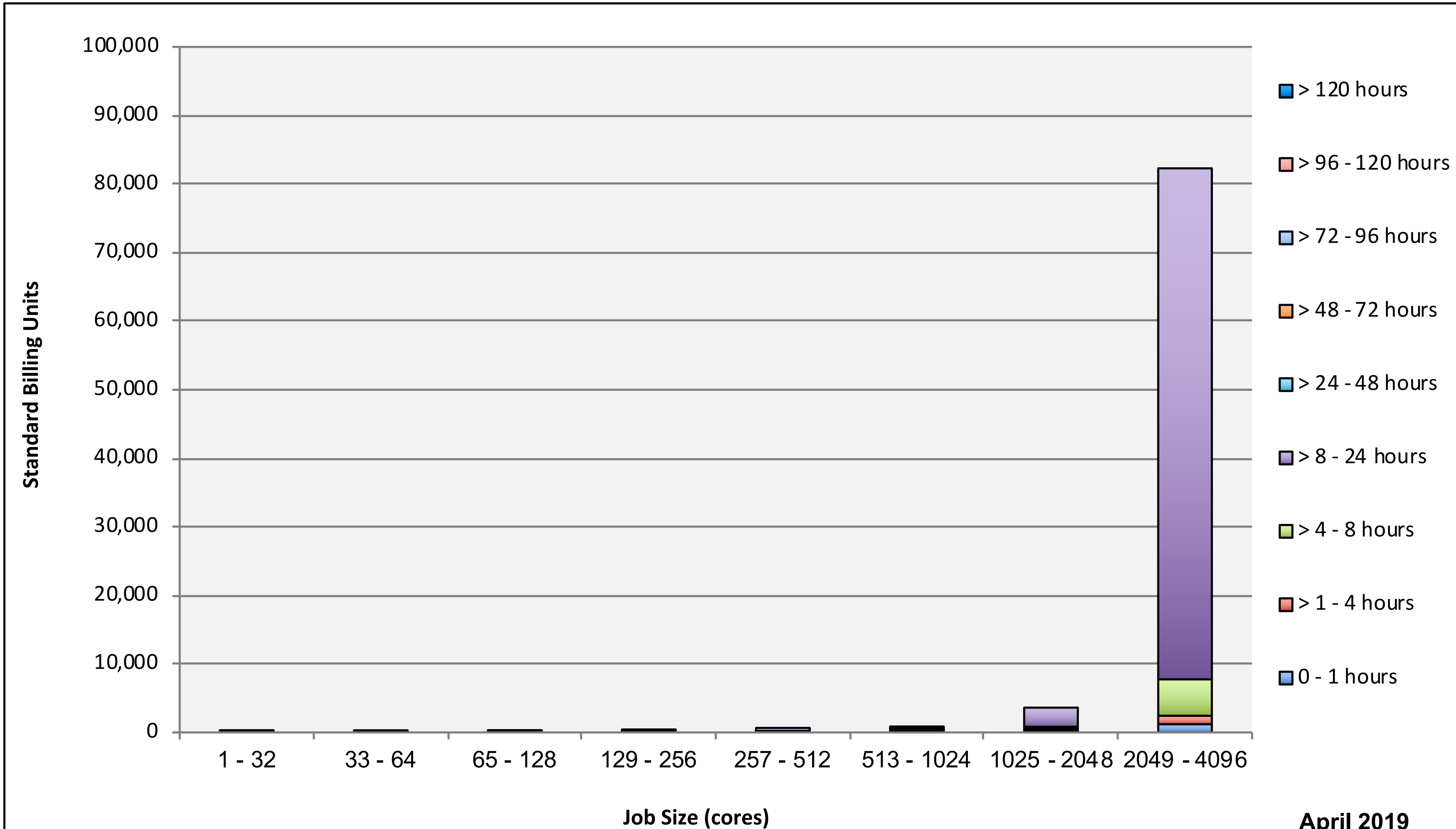
Merope: Monthly Utilization by Job Length



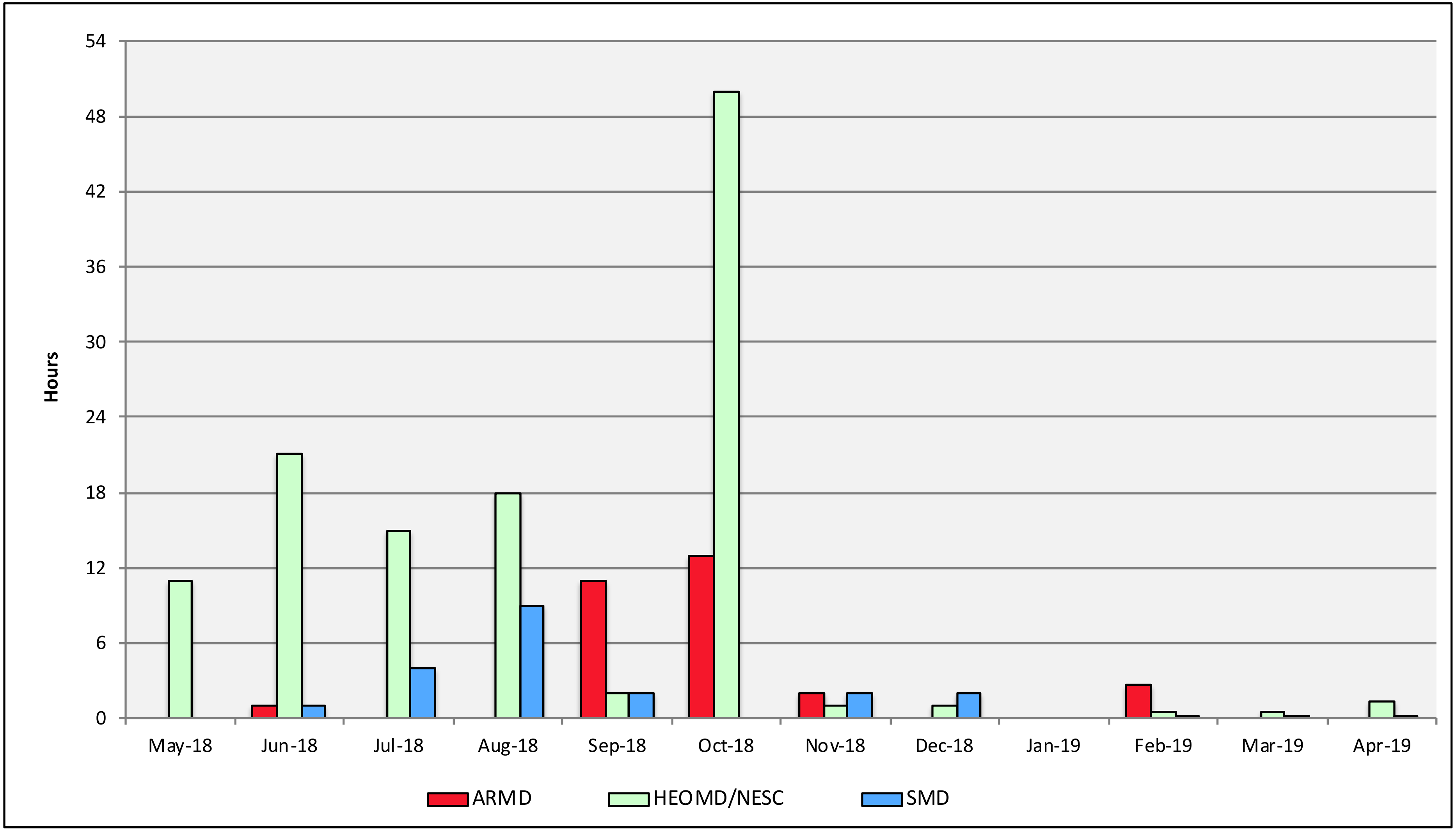
Merope: Monthly Utilization by Size and Mission



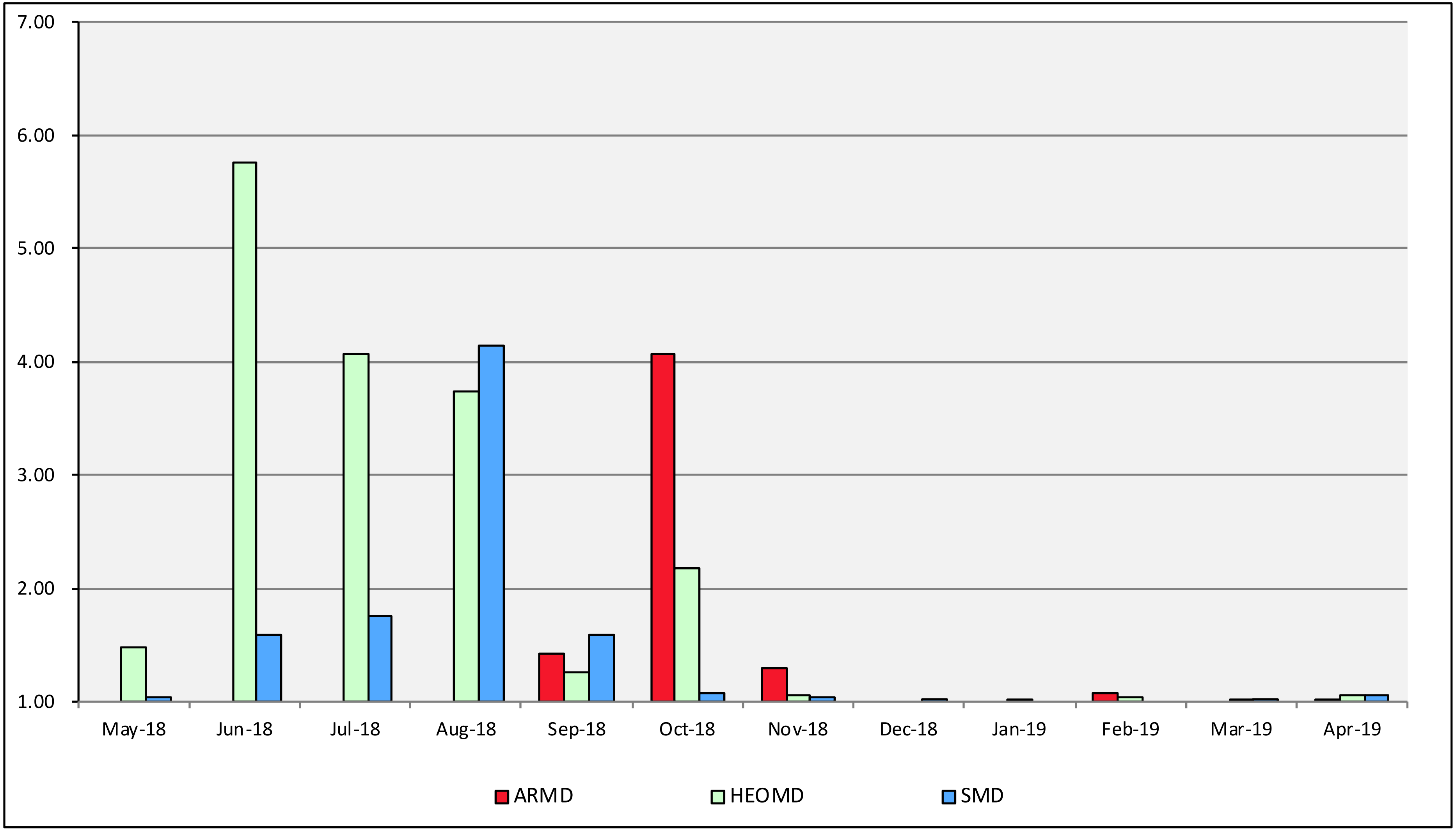
Merope:
Monthly Utilization by Size and Length



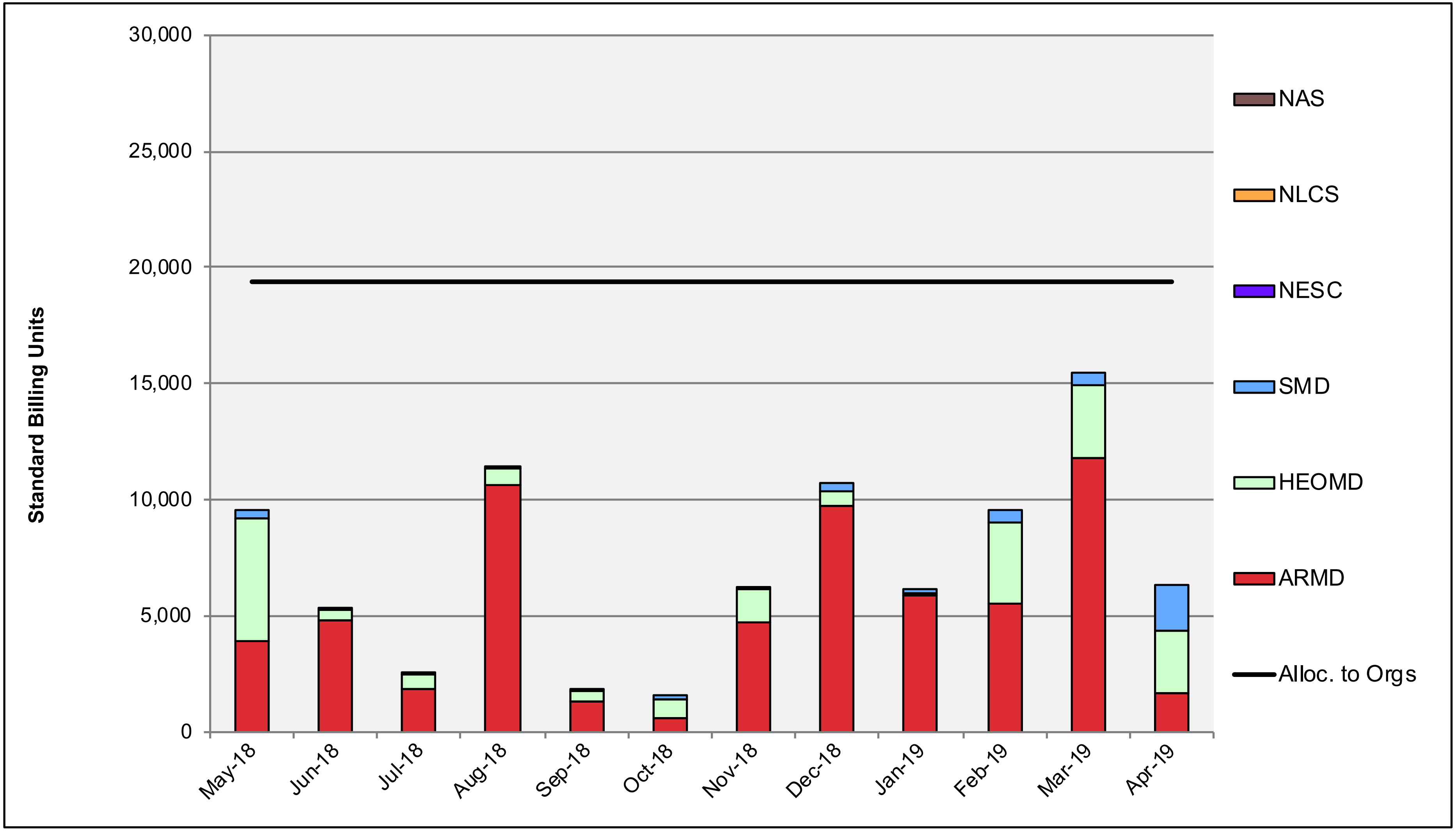
Merope:
Average Time to Clear All Jobs



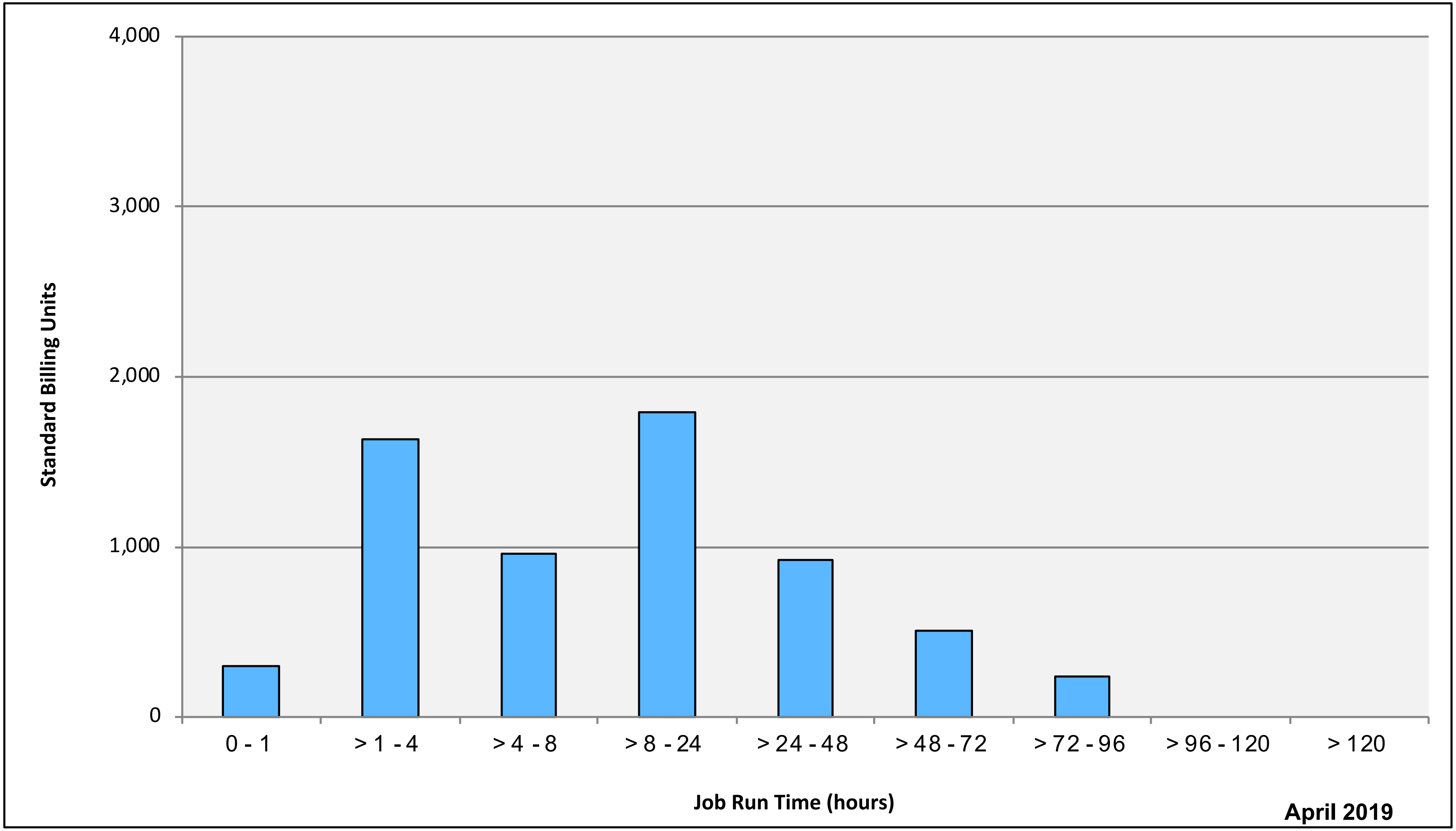
Merope: Average Expansion Factor



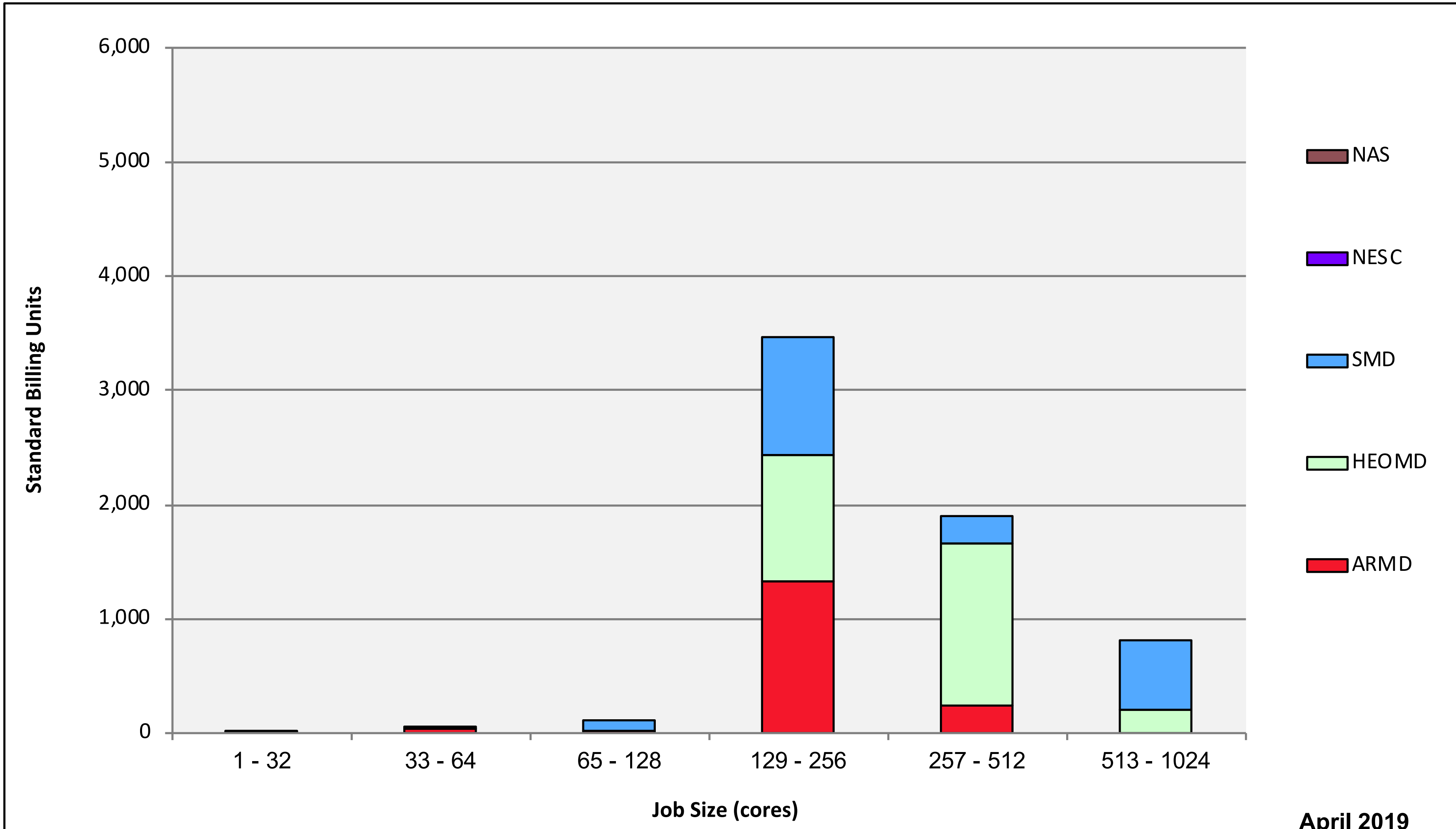
Endeavour:
SBUs Reported, Normalized to 30-Day Month



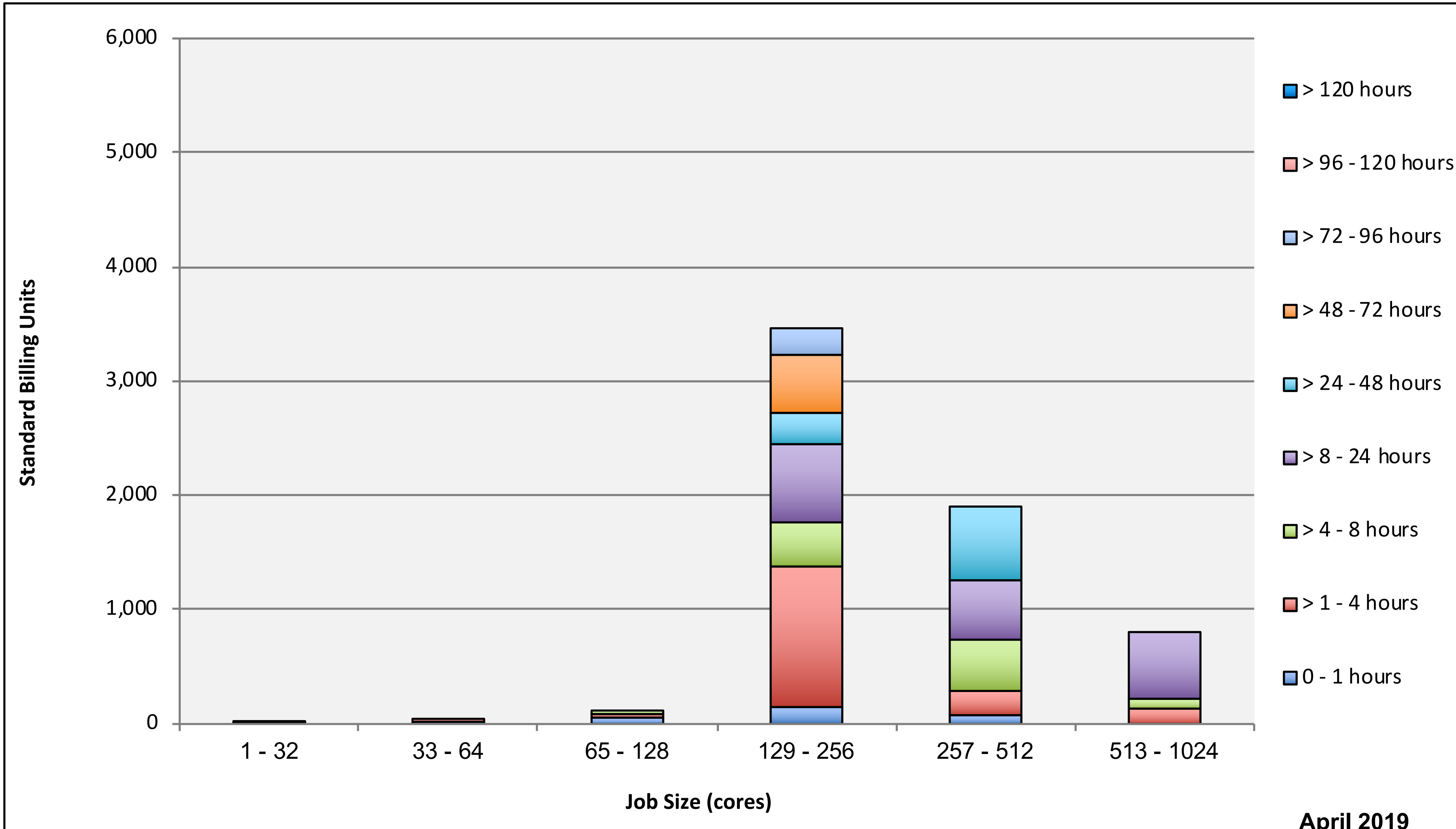
Endeavour: Monthly Utilization by Job Length



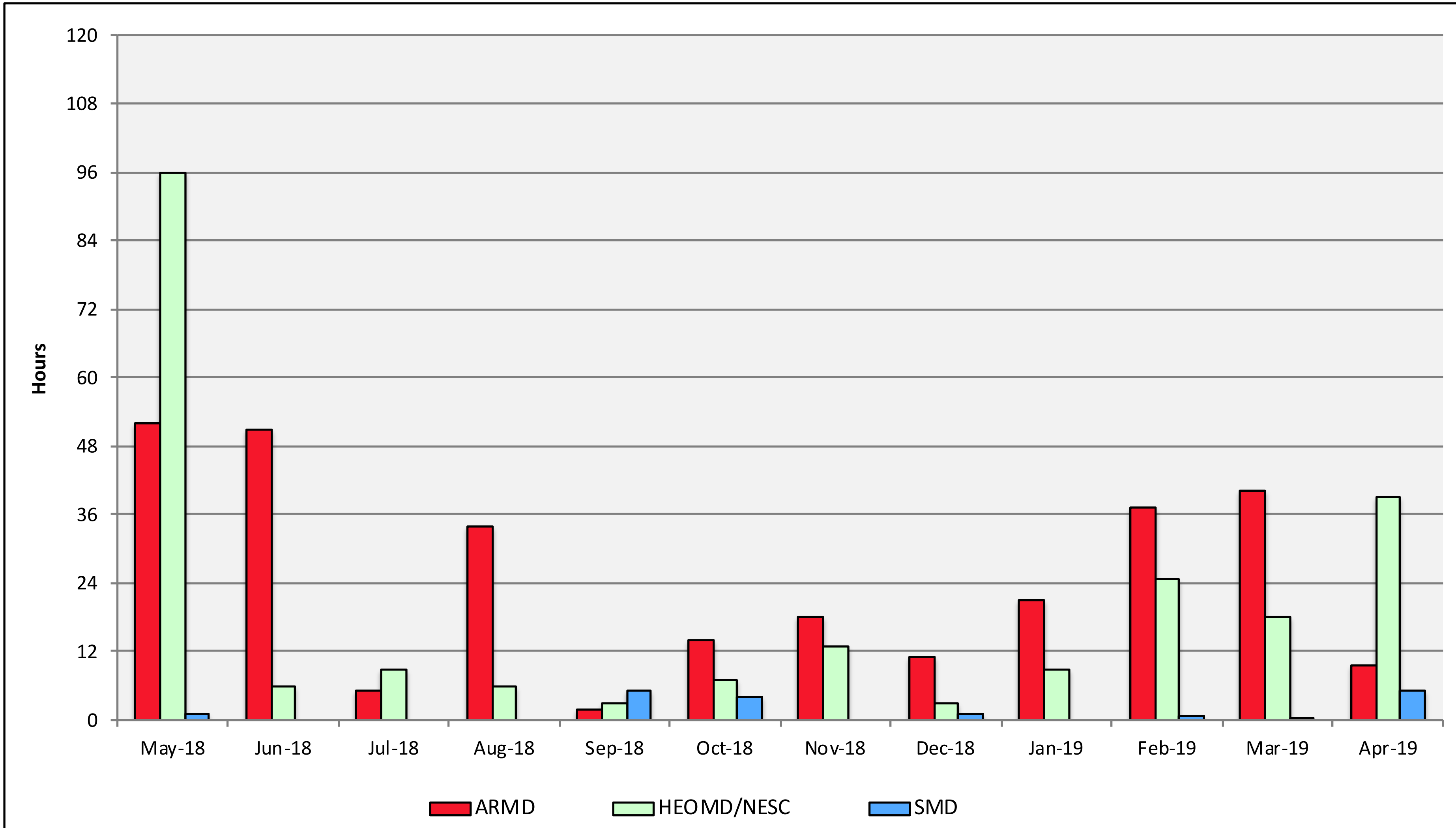
Endeavour:
Monthly Utilization by Size and Mission



Endeavour: Monthly Utilization by Size and Length



Endeavour: Average Time to Clear All Jobs



Endeavour: Average Expansion Factor